

GENETIC PSYCHOLOGY MONOGRAPHS

Child Behavior, Animal Behavior,
and Comparative Psychology

EDITED BY
CARL MURCHISON

JOHN E. ANDERSON
University of Minnesota

CHARLOTTE BÜHLER
Universität, Wien

CYRIL BURT
University of London

LEONARD CARMICHAEL
Tufts College

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FEBRUARY, 1944

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MENTAL CHANGES AFTER BILATERAL PREFRONTAL LOBOTOMY

3

By STANLEY D. PORTEUS AND RICHARD DEMONBRUN
KEPNER, M.D.

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MENTAL CHANGES AFTER BILATERAL PREFRONTAL LOBOTOMY*

STANLEY D. PORTEUS AND RICHARD DEMONBRUN KEPNER, M.D.

The Psychological Clinic, University of Hawaii

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ACKNOWLEDGMENTS

This paper contains an initial report on 20 patients after psychosurgery at the Territorial Hospital for Mental Disorders (E. A. Stephens, M.D., *Medical Director*), Kaneohe, Territory of Hawaii. The operations were performed by Dr. Ralph B. Cloward, Consultant Neurosurgeon to the Hospital.

Dr. Porteus, Psychological Consultant to the Hospital, is responsible for the writing of the summary of previous work, the psychological reports, and the theoretical discussions. Dr. Kepner, Clinical Director of the Hospital, has supplied the clinical notes and psychiatric observations.

STANLEY D. PORTEUS

RICHARD DEMONDRUN KEPNER

The Psychological Clinic

University of Hawaii

Honolulu, Hawaii

FOREWORD

Since ancient times when the mentally ill were compelled to seek refuge in trees and caves, disorders of the mind have excited the curiosity and challenged the ingenuity of man. A perusal of the history of insanity, incomplete as it is, reveals that the methodologies employed have been limited only by the limitations of the human imagination.

With the advent of interpretive psychiatry as formulated by Kraepelin, Bleuler, Freud, and others, it was hoped that cures could be effected by psychotherapeutic measures, but, alas, this hope has rarely been fulfilled. Knowledge of mental mechanisms has, to be sure, increased remarkably in recent decades, but the application of this knowledge is too often frustrated by the regression or inaccessibility encountered in the major psychoses. Since earliest days, a feeling of futility has pervaded all institutions caring for the more serious psychoses.

It is no wonder then that the more drastic methods first introduced by von Meduna with the use of metrazol in 1934 and by Sakel with insulin about the same time were welcomed by workers in state institutions who had become resigned to the use of measures that were, in most instances, no more than palliative. More recently, stimulation of the cerebral cortex by an electric current has been added to the armamentarium of the psychiatrist, and this method, too, has received wide use and acclaim in the fight against mental disease.

Although all these approaches have given encouraging and, in some instances, spectacular results, it must be acknowledged that the earlier promises of success have not been fulfilled. Consequently, state hospitals still have many challenging psychoses that present a serious socio-economic problem because of their chronicity.

About two years ago, it was decided to attempt to meet this challenge in the Territorial Hospital by the use of psychosurgery as first introduced by Moniz of Portugal in 1936 and later by Freeman and Watts of America. The monograph by Drs. Porteus and Kepner that follows is a careful study of the psychological and clinical aspects of our first 20 cases of prefrontal lobotomy. The authors have already acknowledged the contribution of Dr. R. B. Cloward, consultant in neurosurgery to the Territorial Hospital, but I would feel ungrateful if I did not add an expression of my own appreciation of his skill, knowledge, enthusiasm, and sustained interest.

Since the preparation of this monograph, this work has been extended as rapidly as possible. It is proposed to continue until at least 200 cases are

completed as a basis for the appraisal of the effectiveness of psychosurgery. But whatever the results, one may be consoled by the words of John Bunyan who more than three centuries ago said:

Physicians get neither name nor fame by pricking of wheals or picking out thistles or by laying of plasters to the scratch of a pin; every old woman can do this. But if they would have a name and a fame, if they will have it quickly, they must do some great and desperate cures. Let them fetch one to life that was dead; let them recover one that was born blind to see, or let them give ripe wits to a fool. These are notable cures and he that can do thus, if he doth thus first, shall have the name and fame he deserves—he may lie a-bed till noon.

Perhaps Bunyan would not consider the results of lobotomy worthy to rank with the marvels he mentions, and, in any case, lying a-bed till noon is not one of the medical scientist's ambitions. But lobotomy has succeeded in restoring seemingly hopeless psychotics and, as recorded in this monograph, has resulted in returning dangerous criminals to normal conditions of life.

E. A. STEPHENS, M.D.

Medical Director, Territorial Hospital

I. PREVIOUS OBSERVATIONS ON THE EFFECTS OF PREFRONTAL LOBOTOMY

Within the past few years there has been greatly increased interest in psychosurgery undertaken for the relief of certain symptoms in mental disorders. The operation of lobotomy consists in cutting, subcortically, the communication fibres between the prefrontal portions of the frontal lobes and the thalamus, more particularly with the dorsemidial nucleus. This nucleus seems to have the richest connections with the prefrontal regions and is said to suffer the most marked degenerative changes after lobotomy. According to Fulton (5, p. 273), this nucleus is best developed in man and consists of a large-celled and a small-celled portion, the former being connected with the hypothalamus and the latter with the prefrontal areas. Thus this interruption of direct connection between what is, phylogenetically speaking, one of the most primitive structures of the brain and one of the most recently developed areas should have interesting mental consequences which, if carefully observed, should throw additional light on the difficult questions of brain organization and local functioning.

It should be noted particularly that it is the direct line of communication that is severed, and that since the cortex is left comparatively unimpaired, prefrontal connections, though perhaps somewhat roundabout, are still possible with other brain areas through whatever intracortical pathways are available. This fact is important in the light of the varying effects of the operation as hereafter described.

There has been considerable speculation regarding the functions of the frontal lobes. Following both accidental and operative lesions, studies of mental changes have been instituted, but in many cases these observations have not been either careful or long-continued, so that the facts regarding behavior have been poorly correlated. Thus the matter has remained speculative. Harlow's report on the man who survived the driving of a crowbar through his frontal lobes was published as far back as 1868. The victim was able to earn his living and, to casual observation, suffered only minor mental impairment. It was, no doubt, on the basis of inadequate studies of patients suffering from frontal lobe injuries or disease that some authorities have regarded the prefrontal regions as "silent" and therefore luxuries in cerebral development, while others, such as Tilney, have suggested that these areas represent the region of supreme organization in the brain. Lobotomy cases should, we believe, supply much-needed information on this problem.

The new interest in psychosurgery in this country dates back only to 1936, and was stimulated by the work of Moniz, a Portuguese surgeon. By means of an instrument called a leucotome, he cut cores from the white matter in the frontal regions so as to sever many of the projection fibres linking the thalamus and prefrontal areas. The operation was rarely fatal and resulted, according to Moniz, in distinct improvement in cases exhibiting agitated depression, chronic anxiety, delusions of persecution, hypochondriacal or grandiose beliefs—in brief, stereotyped ideas dominating the personality or behavior of the patient. One of Moniz' theories, interesting if true, was that the operation broke up the fixed synaptic patterns which mediated these psychotic manifestations, enabling new and more adequate patterns of response to be formed.

In America, Drs. Freeman and Watts (3) undertook a series of similar operations, but after 20 cases abandoned the Moniz' technique and adopted an improved method of their own. Instead of cutting cores in the white matter and leaving them *in situ*, they severed the direct connections between the thalamus and prefrontal areas by deep continuous bifrontal incisions, leaving the cortical surfaces intact.

The neuropsychological theory upon which Freeman and Watts base these procedures is that the emotional "charging" of ideas takes place through the thalamo-prefrontal connections. They describe the prepsychotic individual as "a rather egocentric, introspective type with a strong drive towards perfection." Such persons tend to project into the future anxiety and fear of failure or inadequacy, a disposition which expresses itself in obsessions, harassing doubts, or phobias. "Threatened security constitutes a grave hazard to those personalities, and the faculty of foreseeing difficulties, crossing bridges, and building mountains out of mole hills is only too well developed in them."¹ For a most interesting discussion of these theories together with a full account of their cases, the reader is referred to Freeman and Watts' volume to which Dr. Thelma Hunt has contributed psychometric data and psychological profile studies of the lobotomy patients.

Cutting the more direct subcortical connections between the thalamus and the prefrontal areas means that the physiological and psychological inter-relationships are changed, not destroyed. It is in this respect that lobotomy

¹What is in most of us a normal anxiety for the future becomes in these cases reactions of panic or exaggerated self-distrust. The theory is that lobotomy blunts the emotional affects, the discomfort of felt or imagined social inadequacy is lessened, making it possible for the individual to react less intensely to frustration or failure.

differs from lobectomy. In the former operation, as formerly noted, there is still the possibility of communication through intracortical connections. The cortex has been called the organ of choice, but lobotomy results, as far as the prefrontal areas are concerned, in slower choices, increasing the chances, in certain psychotic individuals, of more acceptable social reactions. Because there is a two-way connection between the prefrontal areas and the thalamic and hypothalamic regions, the effects of lobotomy may be reciprocally stated. The emotional reactions of the individual may appear to be less intellectualized, or the intellectual reactions less emotionalized. The capacity for emotional behavior may not be significantly changed, but the patient may not choose the same things to be angry or anxious about. In some lobotomized subjects there appears increased irritability with occasional marked emotional outbursts, but the ideas that formerly called forth these outbursts frequently lose their dominance. In short, the pattern of intellectual-emotional behavior has been changed, so much so that the patient may specifically disavow interest in the ideas or situations which formerly excited him. Even when the ideas persist, they may no longer call for violent reactions. However, such beneficial results do not always follow, but vary considerably among patients.

Freeman and Watts offer the rather puzzling suggestion that "perhaps the greatest change induced in the individual by operation upon the frontal lobes is in the intimate relationship of the self with the self" (p. 192, italics ours). This awareness of the self by the self, they go on to explain, is more than self-consciousness and more than the ego-ideal. Undoubtedly, in some cases ideas of personal reference seem to be diminished, after operation, with regard to certain situations. The stimulus is recognized as before, but is reacted to much more reasonably from the social point of view. There is intellectual comprehension without emotional apprehension.

In a former publication (7), one of us (Porteus) attempted to describe behavior in terms of what was called the relevant stimulus. This was defined as the stimulus to which it is biologically advantageous for the organism to respond. The intensity of the reaction is in most situations proportionate to the recognition of the degree of relevancy. In man the range of relevant stimuli is greatly extended beyond the scope of instinctive reactions. Human judgment often falters with regard to the degree of relevancy of the situation and hence the response is so inappropriate as to become anti-social conduct, which also includes psychotic behavior. Freeman and Watts' theory would appear to make the pre-frontal areas the centers

for judgment as to what is pertinent or relevant to the self. Their assumption implies that the choice of response to a relevant situation comes about through prefrontal-thalamic coördination. After lobotomy the connection is side-tracked with consequent changes in behavior.

These authors are careful to point out that much of our behavior is intellectual-emotional. "It is a good thing," they say, "to have a little anxiety, a little fear of consequences, a degree of self-consciousness; these all make for a certain self-restraint in dealing with others in the environment. On the other hand, an exaggeration of these same qualities renders a patient unable to continue functioning effectively, and furthermore causes acute suffering even to the point of suicide or psychosis."

We may state this point of view even more emphatically by saying that from the phylogenetic standpoint, fear and anxiety are two of the most important protective mental mechanisms, and as regards emotional reactions, it is often far better to act immediately than too late or not at all. Only when these feelings pass beyond normal limits, or become attached to the wrong situations, do they become detrimental to individual survival.

It is not within the scope of this paper to present a full discussion of theories relating to lobotomy changes. We would, however, remark that Moniz' suggestion with regard to the disruption of stereotyped synaptic patterns in the brain and the Freeman-Watts hypothesis that the operation robs certain situations involving the self of their emotional "charge" are by no means incompatible. In a recent book, Porteus (11) has suggested the hypothesis that all appropriate responses are circular responses and, following Cajal's suggestion, that the neural pathways become established through the enmeshment of neuronie filaments into definite systems. Just as a tangled skein becomes tightened through tugging on the free ends, so a stimulus proceeding through a neuronie system contracts the dendronie filaments so that they become anatomically engaged, making the passage of a similar stimulus over the pathway easier. If the stimulus-response completes the circuit, a condition of readiness to respond is facilitated. This does not mean that narrowly circumscribed pathways are involved—quite the reverse. The reflex is an example of a "closed circuit." In situations with emotional affects, very widely separated brain areas may be involved in the circuit. By severing the direct communication fibers between the thalamus and the pre-frontal areas, the circuit of habitual intellectual-emotional response is broken. The advantage of the mechanical theory of stimulus conduction² is that it

²A somewhat similar mechanical theory of stimulus conduction has been suggested

explains forgetting as well as remembering. Interruption of the pathways is the equivalent of forgetting the accustomed emotional reaction.

Freeman and Watts' suggestion that the prefrontal lobes are directly concerned with "the relationship of the self with the self" could perhaps be formulated more satisfactorily from the psychological point of view. As it stands, the statement implies duplication of the "self" so that its description might easily read like Gertrude Stein's "a rose is a rose is a rose." Would it not be much simpler to say that these areas underlie an individual's personality in the sense that this is, as Allport (1, p. 24) puts it, "an amazingly complex organization comprising his distinctive habits of thought and expression, his attitudes, traits and interests, and his own peculiar philosophy of life." Noting the occurrence, in the best and clearest definitions of personality, of terms such as *distinctive*, *characteristic*, *unique*, *peculiar* in relation to ways of behavior, Porteus (11, p. 198 ff.) has proposed that the gist of these definitions could be expressed as "style of response." Each of us tries to make his behavior consistent with itself, "well integrated." We are, therefore, continually making judgments as to the propriety or otherwise, for us, of certain courses of action. This or that reaction would not be consonant with our self-recognized style of response. How often does a person say "I could not do that," meaning that the suggested behavior would run counter to the notions he has built up regarding his personality with its self-consistent ways of response. To this notion of ourselves all of our past experience has contributed. Just as the artist's signature, though sometimes rather illegible, appears on any picture he paints, so everything we do bears the imprint of our personalities. When we speak or act or even look out of character, we are acutely aware of it and are usually very unhappy until we can return to our accustomed behavior.

Obviously, somewhere in the brain there must be representation of this totality of experience that determines the lines of personality. The new work in psychosurgery tends to support the view that this representation resides in the frontal lobes. It is perhaps psychologically naïve to suppose that the self possesses a kind of mirror in which it can view itself—an idea inherent in Freeman and Watts' suggestion regarding consciousness of the

by Kappers. He postulated "amoeboid" movements of nerve filaments as the basis of the establishment of response patterns. Contractility of nerve processes provides a more adequate explanation. Sherrington has adduced evidence against the theory, but this does not seem to be as conclusive as some writers assume.

self by the self. But in some way self-standards are set up with which we try to make our conduct or achievements accord.³

To sum up these neuropsychological observations and theories, we may say that the cortex is generally recognized as the organ of choice, the decision in each situation having to do with its relevancy. The frontal lobes of the brain, as is well known, have developed *pari passu* with a great increase of range and complexity of the relevant stimuli to which man must learn to respond. The style of response marks the personality of the individual.

But since so much of human behavior is charged with, or governed by emotion, there must be direct connections between the prefrontal cortex and the centers that mediate our emotional life. These appear to be predominantly the thalamus, and in matters affecting the more instinctive somatic reactions, the hypothalamus. The dorso-medial nucleus seems to be the chief way-station between the emotional centers and the prefrontal cortex, for when the connection is cut, its cells suffer the most marked degenerative changes.

Personality is recognized by some writers as being particularly concerned with social reactions. Burgess, for example, defines personality as "the integration of all the traits which determine the rôle and status of the person in society," while in what Allport (1, pp. 39-40) calls a bisocial definition, personality is made up of "those habits or actions that successfully influence other people." But it is exactly these social reactions into which emotion enters most. Hence, cortical and thalamic areas underlie personality. When cortico-thalamic connections are severed in prefrontal lobotomy, the style of response of the individual may be radically changed.

As an illustrative example, we may consider the so-called anxiety states. In these the patient is excessively depressed or worried over situations that other people more or less easily tolerate. A common fault becomes an unpardonable sin, a minor inadequacy appears overwhelming in its implications of general failure. Evidently these are cortically initiated fears or worries, the excitation being constantly conducted through subcortical channels to the thalamic and hypothalamic regions. The somatic effects of this excitation are such that sleep and ordinary daily life are interfered with and the patient comes to dread situations that ordinary people face with little trepidation. Prefrontal lobotomy by severing these subcortical associations breaks the

³Freeman and Watts seem to make a distinction between "consciousness of the self" and self-consciousness. Porteus has contended that what is ordinarily called self-consciousness really means other-consciousness.

vicious circle. The thalamic centers are no longer as easily excited, there is an emotional dulling, and the situation, although cortically recognized as relevant, is no longer able to call forth the distressing emotional effects.

As another example, we may take the impulsive reactions that distinguish the conduct of manic and in many cases criminal personalities. This kind of behavior is closely identified in the public mind with insanity and this popular view receives support from one of the greatest alienists. It was Charles Mercier who said, "Insanity is a disease of conduct, not of intellect." Apparently sane reactions depend upon a balanced coördination of cortical and thalamic functions so that deliberative judgments result. Severance of cortico-thalamic connections can, therefore, be expected to diminish impulsive behavior by lessening the emotional influence.

Incidentally, we would suggest that we should speak less of control of lower centers by higher. We should remember that emotion is just as necessary to survival as intellect. A man absolutely devoid of fear would probably not live at most more than a few days. Nor does sanity nor righteousness depend on inhibition alone. If this were so, a catatonic case would be both sane and righteous. Nevertheless, too rapid impulsive action is socially harmful. Apparently a deliberative period is essential to cortico-thalamic balance. Someone has said that there is a world of difference between a murderer and the man with his finger on the trigger; the difference, however, may be only a matter of seconds. Prefrontal lobotomy may slow reaction to the point where it serves instead of a deliberative pause.

Because there are so many different personalities, each with its unique ways of reacting, the changes which follow psychosurgery are extremely varied and apparently opposite effects ensue. Thus the manic may become quiet, the extrovert self-possessed, the depressed euphoric, the hyperactive lazy, the perfectionist haphazard, the anxious indifferent, the aggressive unenterprising. These and many other changes have been recorded in individual post-lobotomy personalities.

These results give general support to the Moniz theory that the cutting of the cortico-thalamic fibers breaks up "the more or less fixed arrangements of cellular connections that exist in the brain," and which he believes are related to "the persistent ideas and delusions of certain morbid psychic states." In other words, one of the great circuits of response is severed. It is not strange then that with the breaking of those circuits, into which new responses would ordinarily be switched or connected, a period of mental confusion follows in which planning and initiative are extremely difficult.

Post-lobotomy patients often lose the power to profit by experience because the traces of that experience no longer operate to the same extent in influencing responses. The impairment, however, may be temporary and new adjustments apparently are still possible.

We are fully aware of the fact that in thus formulating these psychoneurological theories we are suggesting conclusions in advance of the demonstration of the facts, but this is perhaps advantageous. In presenting detailed case histories, there is necessarily such a formidable array of observations that the reader may himself become mentally confused by their apparently contradictory nature. If the aviator can pick up a beam, navigation becomes so much easier.

The above summary of the neuropsychological basis of the mental changes following lobotomy, it should be pointed out, is an interpretation of theories to which Freeman and Watts may not fully subscribe. It is, however, quite in line with Herrick's suggestion, which they quote with approval, that it is through the prefrontal and thalamic connections that there is brought about a blending of cognitive and affective experience shaping the course of action and giving the response dynamic power and volitional motivation.

Freeman and Watts give us an excellent summary of observations bearing on the effects both of lobectomy and lobotomy so that only the briefest outline of some of the more significant of these is needed here. Of special importance, of course, are Bianchi's well known experiments on bilateral frontal lobe extirpation in monkeys. Reduced memory and powers of association, lack of initiative, incapacity to keep an objective within the focal point of consciousness represent characteristic intellectual deficits following the operation. As regards social adjustments, disappearance of jealousy, self-esteem, friendship, and gratitude are among the most striking personality changes.

Jacobsen, whose work with rhesus monkeys is equally well known, noted defects in immediate memory, but Malmo produced evidence to show that it was extreme distractibility rather than loss of memory that was to blame. Some problems, apparently insoluble under ordinary conditions, were worked out correctly in the dark. Like Bianchi's subjects, Jacobsen's lobectomized cases did not show normal reactions to frustration or failure, thus indicating an emotional dulling. We would offer the suggestion that this was due not to incapacity to recognize failure, but rather an inability to realize its relevancy.

With regard to the behavior of persons suffering from frontal lobe tumors, Donath instances apathy, moral obtuseness, and difficulty adapting themselves

to new conditions of life. He confirms the observation by other investigators that such patients exhibit incapacity to discern the essentials of a situation though they may appreciate the significance of each separate part as a unit. This is described as loss of the power to synthesize.

Rylander in Sweden appears to have carried out the most extensive series of studies of lobectomy cases. The great majority of those who suffered unilateral removal of a frontal lobe showed distinct changes in personality. Lack of tact and diminished restraint in social relationships and what was called "affective incontinence" were commonly features of their behavior. Loss of initiative was observed in 12 patients and unproductive activity and restlessness in 14. There was, however, little disturbance of attention, comprehension, visual perception, and memory span for digits or syllables, although associative links tended to weaken over a period of time. The greatest mental impairment was apparent in those cases that had formerly attained a high level of intelligence.

Slow thinking, inability to deal with complicated tasks, easy distractibility were also noted by Rylander. Patients were weak in tests of logical memory, defining abstract words, interpreting proverbs, fables, and pictures. *IQ*'s generally were lower than in a control group. These unilateral frontal lobe lesions do not, according to most accounts, occasion mental deficits. However, observers may have been misled by the superficial appearances of normality. Only when tests are used are the deficiencies apparent.

The following conclusions of other observers agree with Rylander's studies: conspicuous changes in emotional behavior and personality (Baruk); defects in volition (Feuchtwanger, Foerster and Kleist); deterioration of higher intellectual functions and difficulty in grasping essentials of a situation and reduction of capacity for abstract thinking (Brickner, Goldstein, Van Woerkom). Though these all occurred in cases of lobectomy, some similarities exist between the personality changes in these cases and those observed after lobotomy.

Brickner's case is most interesting, not only because of the detailed observations of his patient's behavior but also on account of the extensive cerebral insult. The frontal lobes were removed back almost to the premotor area. Emotional changes were very evident. Aggressive, negativistic, and puerile impulses were observed, as well as boastfulness, tactlessness, euphoria, ill-timed facetiousness, indecent acts. Conspicuous also was the patient's lack of insight into his own condition. Apparently, judging by these observations, the capacity for what we may call considered behavior, especially the

choice of appropriate social reactions, is largely dependent upon the proper functioning of the frontal lobes.

A study of a case involving partial frontal lobectomy by Nichols and Hunt (9) is worthy of special mention because of the careful reporting of psychological test results. They noted specifically a failure to appreciate the total situation in the Vigotsky test, an "apparent" loss in immediate memory as shown by a seven-to-eight-year performance in the Knox Cube test, failure to see figures in the Ishihara plates for color vision, and inability to analyze the more complicated systems involved in arithmetical progression series. Very significant, in view of our own experience with the Maze test, to be described later, is the authors' observation that the patient "seems to have lost the capacity to sustain several parallel lines of activity separately." They also note that the loss in immediate memory was more apparent than real because when the patient was shown how to organize the given material by grouping, his memory span seemed adequate. But in our opinion, all cases improve their performance if shown how to group immediate memory material. In Nichols and Hunt's opinion, the intellectual deficit seemed to be "a defect of *abstract behavior* at a relatively high level."

Summarizing briefly the general picture as presented by various observers, it may be said that severing the subcortical connections between the prefrontal areas and the thalamus has, for many patients, on the emotional side, the effect of diminishing tension, anxiety, extreme resentment, impulsively violent acts and temper tantrums when these traits were previously characteristic of their behavior. Along with these personality changes often goes a tactlessness that indicates a lack of foresight as regards the effect of actions on others. Impulsiveness, irritability, and lack of social restraint may still be evident but operate at a less consequential level. Heedlessness rather than malice is apparent. Freeman and Watts remark that there is "no weighing of possible consequences, no seeking after effect."

Our own formulation of the effects of the operation would support Moniz' suggestion that synaptic patterns of relationship are changed. Intellectual appreciation of situations may continue as before, but emotional affects are lessened or eliminated. Stimuli that were once considered extremely relevant lose some of that relevancy, and hence the emotional reactions are different also. Normally, this integration of the emotional and intellectual life has great value and importance to the individual. Only when there is chronic mental disorder is it justifiable to attempt to break up the pattern of response by operation, as this may, and usually does, substitute one abnor-

mal situation for another. In the majority of carefully selected cases, the credits outweigh the deficits so that the last state of the patient is better than the first. The detailed reports that follow are set forth in the hope that they may help to establish a basis for the selection of the most hopeful cases for operation. They may also throw further light on the question of the functional activities of the prefrontal areas, especially in correlation with the thalamus and hypothalamus.

II. THE PRESENTATION OF CASES

A. PATIENT NO. 1

Our first case is of special interest since it represents an instance of frontal lobotomy performed on a confirmed criminal. The patient has been under postoperative observation for a full year. A résumé of his behavior in the hospital prior to the operation follows:

Patient C—, an American negro about 55 years old, was transferred from the Oahu Prison in Honolulu to the Territorial Hospital on January 1, 1941, because of mental symptoms of several months' duration. At that time he was serving a sentence of five years for assault and battery with a weapon dangerous to life, this being the latest of a series of similar offenses.

His personal and social history showed that he was born in Atlanta, Georgia, and that he completed the fifth grade at the age of 15 or 16 years. Shortly after leaving school, he enlisted in the 10th Cavalry and deserted. While serving a military sentence, he became involved in a cutting affray and was sent to Fort Leavenworth. After his release and dishonorable discharge from the army, he wandered about the country working at a variety of jobs such as teamster, hotel bus driver, shoe shiner, porter, molder, asphalt worker, bricklayer, waiter, shoe repairer, seaman, salesman, WPA worker.

This job record was broken into by several terms of imprisonment. He served four years in the Iowa State Reformatory; then after a stabbing affray there he was transferred to Fort Madison State Penitentiary where he served another five years. He was returned to that prison as a parole violator.

His next sentence was for burglary, for which he served 33 months at Joliet. The third stabbing in which he was involved took place in San Francisco, and for that offense he was imprisoned for a year. Several years later he was again involved in a stabbing in Hilo. He got into a fight with a man in a saloon and inflicted over 40 superficial wounds with a short bladed pocket knife. C— stated that he kept his knife blade under 3½ inches so that he could not be accused of carrying a concealed weapon. The complainant in this case having left the Territory, this charge was "nolle prossed."

His final offense was another assault with a weapon "obviously and imminently dangerous to life," in this case a Gem razor blade mounted on a handle. In each assault, the behavior pattern was similar—acute resentment over a

GENETIC PSYCHOLOGY MONOGRAPHS

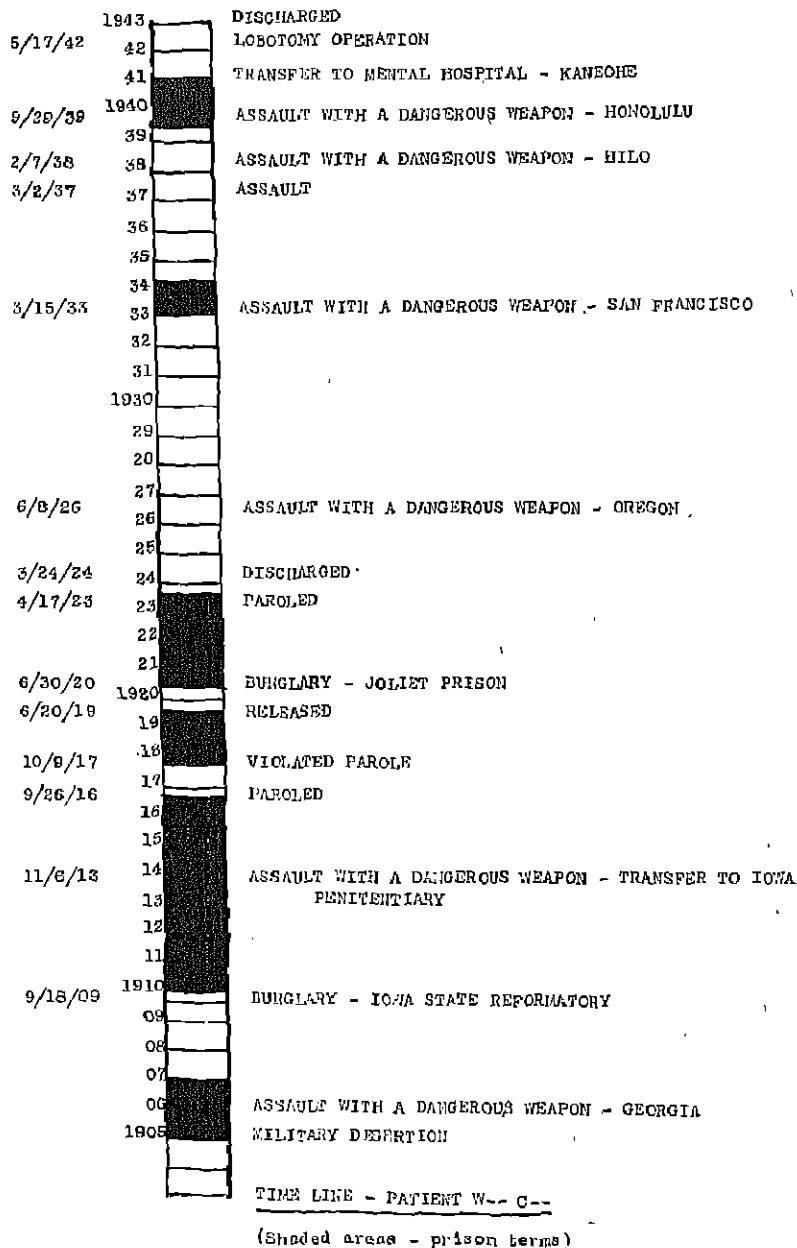


FIGURE 1

slur on his negro blood followed by a fight and a stabbing or cutting. There is no doubt that C— was a particularly vicious and violent negro. In order to provide a graphic representation of his criminal career, his prison record is given in the form of a time line (11, pp. 371-375) (Figure 1).

On admission to the Oahu Prison on September 30, 1939, he was found to have gonorrhea, which responded readily to treatment. There was an operative scar from amputation of his right breast in 1913 for a tumor of unknown type. Chest X-ray was negative for tuberculosis in spite of a positive Vollmer patch test. No other abnormalities were noted on physical examination. Blood Wassermann and Kahn were negative, although the patient gave a history of treatment for syphilis.

With the exception of minor physical ailments, his health was good until the onset of psychotic symptoms in October, 1940. At that time he began to complain of nervousness, and had frequent intestinal upsets for which no physical basis could be found. He became excited and noisy and thought the warden and his fellow prisoners were conspiring to kill him to get hold of patents for valuable inventions. On December 2, 1940, the prison physician recommended his transfer to the Territorial Hospital for Mental Disorders.

On admission to the hospital on January 1, 1941, the patient was quiet, orderly, and coöperative. His general physical condition was essentially as described at the prison. Spinal fluid examination was done and was reported as negative.

Psychiatric observations and examinations showed the patient to be quiet, orderly, cheerful, and coöperative at times; but surly, irritable, and aggressive at others. His stream of thought was occasionally somewhat rambling and his speech was full of big words that he didn't quite understand. He was at all times correctly oriented as to person, time, and place. His memory was on the whole correct for both recent and remote events. Retention and calculation were somewhat impaired. Hallucinations were present for a short time after his admission. Voices told him to do away with himself and broadcast his name over the radio. He believed he heard the voice of the warden hiding in the hospital. These hallucinations ceased in a relatively short time after his admission. Voices told him to do away with himself and were still concerned with the supposed conspiracy to steal his patents. He felt that he had been sent to the hospital without cause and was being persecuted because of his race. He blamed others in each instance for starting the various fights in which he had participated. He claimed to have super-

human powers and to be very popular amongst officials and people in general. He believed all he had to do to get out of the hospital was to call on the soldiers. He said Governor Poindexter was one of his best friends, and also the Secretary of the Interior, whose name he could not recall. He wrote numerous long rambling letters to the staff and to various persons—including President Roosevelt and Governor Poindexter—complaining of the food and treatment and demanding his release.

Judgment was poor in regard to his predicament, and also in regard to his general life situation. He did say that he was through cutting people with knives and razors. Insight was lacking. He believed himself well physically and mentally, and felt that everyone else, including those who committed him, were crazy.

A diagnosis of dementia praecox, paranoid type, was made. It was felt that this psychosis was superimposed on a psychopathic personality.

Subsequent course showed no improvement. He continued to be frequently a bad, vicious negro and was the subject of numerous special incident reports as the result of his attacking other patients.

Because of his long history of social maladjustment and homicidal tendencies, the medical staff recommended C— for Freeman's operation, bilateral trephine and bilateral prefrontal subcortical leucotomy, otherwise known as bilateral prefrontal lobotomy. With the approval of Dr. E. A. Stephens, Medical Director, this operation was performed on March 27, 1942, by Dr. R. B. Cloward, neurosurgeon to the Territorial Hospital.

This operation consists of cutting the white matter of the prefrontal lobes with a flat instrument with relatively dull edges, which is inserted through a trephine opening in each side of the skull. The trephine openings are made at a point 3 cm. behind the outer angle of the orbit and 6 cm. above the upper border of the zygomatic arch. This point usually overlies the coronal suture. A small incision about 2 cm. long is made in the scalp, the temporal muscle removed from the skull, and a single trephine hole made in the skull. The dura mater is opened in a stellate fashion and a small area about 3 or 4 mm. is cauterized in the pia mater over the cortex of the frontal lobe. A brain puncture needle is then inserted into the frontal lobe to determine the depth of the falx cerebri, which averages between 6 and 7 cm. from the surface of the lobe, and also to locate the tip of the frontal horn of the lateral ventricle. This is necessary to determine the proper depth and direction for the incision, which should pass just a few millimeters anterior to the tip of the ventricle and lie in the plane of the coronal suture of the

skull. If the incisions are made too far anteriorly, the desired mental changes are not likely to be achieved; if too far posteriorly, too much mental dulling may follow. The cutting instrument, a Killian nasal periosteal elevator, is then inserted into the brain to a depth 1 cm. less than the measurement from the surface of the hemisphere to the falx. This allowance of one centimeter is for the purpose of avoiding the cortical gray matter of the medial surface of the frontal lobe and obviates the danger of doing damage to cortical blood vessels and to the anterior cerebral arteries. The instrument is gradually worked through the brain tissue, the resistance encountered being similar to that in cutting soft butter. The incision is first made upward toward the vertex of the skull and then downward toward the floor of the frontal fossa until a fan-shaped incision is completed to the entire depth of the white matter of the frontal lobe. If sufficient white matter is not severed, the desired results will not be obtained; if the cortex is damaged, not only bleeding but also further impairment of the intellect may ensue. As a rule, very little bleeding is encountered; occasionally a few cubic centimeters of blood will gush from the wound upon removal of the knife, but this usually stops in a minute or two. After the incision has been completed in both frontal lobes, the brain puncture needle is inserted in the track of the incisions and through it a few drops of iodized oil (lipiodol) injected so that the location and extent of the incisions in the brain can be visualized by stereoscopic X-ray films. The wound is then closed by packing the small holes in the skull with the bone chips removed by the trephine. The star opening in the dura mater is not closed. The temporal muscles of the scalp are closed with fine, interrupted black silk sutures. The patient is usually kept in bed from five to seven days, after which he is permitted to be up and about the ward.

C— went through the operation satisfactorily. He was somewhat dazed, confused, and restless for several days, with some difficulty in urination and later incontinence. He seemed to understand and appreciate the extra care he was getting, and said he must be somebody because he was being cared for. He seemed to have forgotten his manners and would undress in front of women without shame, wandered about in underclothes, sat on the bed and wet his drawers, and then changed the same. He was much slowed up in all motions and actions. He would take an hour or two to dress and make his bed and deliberate at length on his next move, which was performed with meticulousity. In about two weeks he began to polish brass,

wipe walls and window panes of his own accord, doing the same thing over and over again for as long as three hours without ceasing.

He was confused, urinated in the wastebasket and elsewhere, took showers lasting two hours, left the faucets running. He was slow in getting out of bed, slow in working, accomplished little because of his lack of system. He seemed much more cheerful than before the operation, listened attentively, but didn't seem to understand commands.

By May 1st, five weeks later, he was much improved—cheerful, less confused, responding and working better, eating properly, washing hands and face before meals, helping other patients. He attended a dance May 16th and reported having a good time. However, he scolded other patients and even struck a few of them for not keeping the ward in order and obeying the rules. They complained that C— bullied them. He was sarcastic and easily irritated, and too quick with his fists. He became fond of giving fatherly advice to both old and new patients. On May 24th, he wrote another letter to the President. On June 10th, he asked to get in touch with the Attorney General in regard to his invention. During that month, with occasional lapses into irritability, he became more friendly, cheerful, coöperative, agreeable. On July 9th, he was given outside privileges. He dressed well, took good care of his person, and enjoyed himself about the wards and at the dances.

In December, 1942, he was put to work with a field gang and did well there. At a conference April 8, 1943, he was considered much improved and recommended for discharge.

On May 14, 1943, he was returned from the Territorial Hospital to Oahu Prison, where he was discharged, his maximum sentence less commutation having expired. On June 9, 1943, he was made a paid employee of the Territorial Hospital, where he was formerly a patient. Though he caused no trouble, as a painter's helper he was extremely slow and showed no initiative nor planning. He was transferred to the mainland and significant of his present condition is the fact that he appeared at the dock without identification papers or any equipment for a voyage.

For some time previous to his discharge he had been docile and obedient, although occasionally a bit irritable. His orientation, memory, retention, and arithmetical ability seem unimpaired. Hallucinations have not been present since the operation. His delusions have vanished except that he continues to talk of his patent (which may not be altogether a delusion). Ideas of reference are no longer in evidence. Even resentment toward being

called a negro has vanished. Judgment in regard to his situation and his future has improved. He now is willing to listen to his physicians and accept their advice as to his future. Insight is present to a certain extent in regard to his former mental illness. Remaining, and acquired since lobotomy, are his slowness of action and thought, some lack of initiative, a definite meticulousness in all his performances, associated with occasional irritability.

The only report obtainable as to C—'s adjustment to prison life on the mainland was one from Joliet, and indicated very unsatisfactory reactions:

Coöperates poorly, suspicious, evasive, unable to adjust properly to civil and penal life. Self-centered and arrogant, makes no particular effort at adjustment. Mental age 12 years. Very unstable and self-centered, very egoistic, many reactions inferior and subnormal.

This report was confirmed by Dr. Charles Honzik of the staff of the Psychological Clinic, University of Hawaii, who examined C— at the prison in October, 1939, and found him to have decidedly psychopathic tendencies. The examiner made the following comments:

It was my impression after a lengthy interview with him that he undoubtedly has some very good traits, but that he is nevertheless a dangerous person in the community. This is because of his great sensitiveness, amounting almost to a neurosis, regarding his race.

A modified composite form of the Terman-Merrill Binet,⁴ in which there is a lesser emphasis placed on verbal tests, was administered by Dr. Honzik. The examiner noted that C— had a rote memory very much above his general mental level, being able to repeat nine digits, a superior adult immediate memory span. The mental age was 14 years 7 months, *IQ* 104, using a divisor of 14 years to obtain this mental ratio.

The accompanying "Paradigm" of test results allows of a detailed comparison of the patient's preoperational and postoperational responses (Table 1). Chronologically, these examinations took place approximately (a) two and a half years before the operation, (b) 12 weeks after, (c) 16 weeks after, (d) 8 months after, and (e) 11 months after the operation.

This paradigm shows at a glance that in ability to make simple computations, in vocabulary, in ability to see the absurdity of pictures at a 12-year level, in thinking out a "plan of search," there has been no impairment of

⁴This scale, consisting of tests selected from Forms *L* and *M* of the Terman-Merrill Binet, is specially adapted for cases with language or educational handicaps (11, pp. 124 ff.).

TABLE 1
PARADIGM OF BINET TEST RESULTS

Year	No.		Terman- Merrill	10/39	6/42	7/42	11/42	2/43
IX	1	Weights	Stanford IX-2	+	+	+	+	+
	2	Makes Change: 10c-6c; 15c-12c; 25c-4c	L-IX-5	+	+	+	+	+
	3	4 Digits Reversed	L-IX-6	+	+	—	—	+
	4	Dissected Sentences	M-IX-2	+	+	+	+	+
X	1	Absurd Picture	L-X-2	+	+	+	+	+
	2	Reading and Report	L-X-3	+	—	—	—	—
	3	Word Association— 3 minutes	L-X-5	+	+	—	+	+
	4	6 Digits Forward	L-X-6	+	+	+	+	+
XI	1	Memory for Designs	L-XI-1	+	—	—	—	+
	2	Abstract Words: con- nection; compare; obedience; conquer; revenge	L-XI-3	+	—	+	+	+
	3	Bead-Chain	M-XI-1	+	—	—	—	—
	4	Arithmetic: 25c + 10c + 5c; 25c × 5; \$3 — \$2.25	New	+	+	+	+	+
XII	1	Vocabulary	L-XII-1	+	+	+	+	+
	2	5 Digits Reversed	L-XII-4	+	—	—	—	—
	3	Memory for Design	M-XII-1	—	—	+	+	—
	4	Absurd Picture	M-XII-5	+	+	+	+	+
XIII	1	Plan of Search	L-XIII-1	+	+	+	+	+
	2	Dissected Sentences	L-XIII-5	+	—	—	—	+
	3	Bead-Chain	L-XIII-6	—	—	—	—	—
	4	Abstract Words	M-XIII-4	+	—	—	—	—
XIV	1	Vocabulary	L-XIV-1	+	+	+	+	+
	2	Absurd Picture	L-XIV-3	+	—	—	+	+
	3	Ingenuity Test	L-XIV-4	—	—	—	—	—
	4	Changing Clock Hands	Stanford XIV-6	—	—	—	—	—
Average Adult Superior	5	7 Digits Forward	New	+	—	+	+	—
Adult II Superior	3	8 Digits Forward	L-SA-2	+	—	—	—	—
Adult III Superior	4	9 Digits Forward	L-SA-6	+	—	—	—	—
Mental Ages				14-6	11	11-3	11-9	12-6

ability. In five successive examinations, *C*—'s range of vocabulary in the Terman-Merrill test was 14, 14, 15, 14, and 18 words respectively. These results support the inference that the earliest acquired or most continuously used abilities are the last to be affected adversely. However, when mental flexibility is called for as in the definition of abstract words, or in the rearrangement of "scrambled" sentences, there was at first a deficit followed by a later recovery. In repeating digits reversed, however, the loss seemed more permanent.

Contrary to results obtained by other investigators, it is in the area of immediate memory that postoperational deficits were most apparent. In logical memory the patient failed as low as the 10-year test of reading and reporting a simple news paragraph. His attempts gave a fine example of a man lost in a maze of verbosity. In describing the actions of the firemen, as recorded in the test paragraph, he said: "They saw the situation was very complicated and they took steps according to the instructions they had received prior to their coming where the fire had broken out." This was the patient's elaboration of the simple item "they took some time to put it out." It should be noted, however, that this extreme verbosity was always characteristic of *C*—, but after the operation he had even greater difficulty in keeping to the thread of the narrative.

Memory for design is also seriously affected in this case, as shown by three successive failures. The final success at the 11-year level may be ascribed to practice effects, although on the last examination he failed on the 12-year design. The reproduction of the bead designs from memory, which might be described as a test for "serial" memory, was also failed both at the 11- and 12-year levels. Possibly the most striking memory deficit was as regards the repetition of digits in order. From a nine-digit span the patient retrogressed to a six-digit span with, later on, irregular successes in repeating seven digits. This rather outstanding rote memory ability in *C*—'s case has thus markedly diminished.

It should be noted that the loss of immediate memory in *C*—'s case is not typical. In summarizing the observed deficits in cases of bilateral symmetrical softening of the frontal lobes, Freeman and Watts say, "It may be stated emphatically that no such profound loss of immediate memory is induced by surgical lesions, even though they are placed in the same vicinity." This statement also seems to agree with Rylander's experience, although as previously noted, he found that the losses were greatest where the level of

intellectual development was high, as was the case with C—'s rote memory span.

Summing up these results, we can say that in rather mechanical, straightforward tests with familiar material there has been little, if any, loss of ability. In less familiar operations involving mental versatility, especially where material must be kept in memory and rearranged in a different order, the case stands differently. It is not so much that his span of attention has been lessened, but rather that it is more difficult for him to divide his attention between two activities even if they are related. While he is pursuing one objective, the next step in the problem is obscured in consciousness. He has essentially a one-track mind. This finding is in line with the following observation made by Nichols and Hunt on their patient: "He seems to have lost the capacity to sustain several parallel lines of activity separately."

Further confirmation of this conclusion, if valid, should be forthcoming from C—'s performance in the Maze Test. The scale, as is well known, consists of a series of maze designs graduated in difficulty from a 3-year to an adult level. In working through these designs the subject is confronted with an increasing number of choices as to direction, the correct decision in each case being dependent, first, upon the subject's ability to look ahead and plan his course, and secondly, upon his *tendency to use* such a prudent reaction. Because many individuals have not developed such a habit of cautious premeditation, they fail to look ahead and thus fall into error. Some persons when they make a mistake and find themselves blocked tend to become confused and even more hasty in their reactions, with the consequence that they make other errors. The ability to plan is perceptual and therefore related to intelligence; the willingness to plan or the habit of careful planning seems to be more a matter of temperament.

As the tests become more difficult, false leads in the shape of openings ending in blocked paths are introduced so that the subject is compelled to plan not only one step, but two or more in advance, and to make a choice of paths accordingly.

In the examination given in 1939 by Dr. Honzik while C— was still an inmate of the Oahu Penitentiary, his level of performance in the Maze was 11 years. He made no errors in tests below this level but required two trials in that test. He took three trials for the 12-year design and failed in four trials at the 14-year level. The resultant test quotient was 79. This result was in rather marked contrast to the Binet *IQ* of 104, and may be interpreted as indicating that his practical ability was not in proportion to

his verbal ability, and that temperamentally he was inferior. This conclusion was borne out by his work history. Most of his jobs, such as shoe-shining, restaurant waiter, kitchen helper, general laborer, were at a low industrial level.

Dr. Honzik's notes on C—'s Maze performance read as follows:

Execution fair; lines wavy. Studies whole maze first; spots exit before starting. Careful at choice points. Became very slow in reactions in eleven-year and higher tests; 1' 30" for 11, 1' 15" for single 12-year trials (neither test finished). Extremely hesitant, indecisive movements; couldn't get started. Poor planning ability.

Recently the value of the maze as an index of traits of temperament, particularly those affecting the social adjustment of criminals and delinquents, has been greatly improved by a system of qualitative scoring. Under this scheme weighted penalties are allotted for every breach of instructions against lifting the pencil or crossing lines, as well as for cutting corners and making errors in the last third or first third of a test design, and for generally slipshod execution. These penalties are summed up in a weighted error or qualitative score.

It has been shown by repeated investigations that high qualitative scores are characteristic of criminals, delinquents and, in another study, of unsatisfactory industrial workers. C—'s score was 81, whereas the average for delinquent males was 47 and criminals 57, while non-delinquent adult males averaged about 15 points. Thus C—'s performance was considerably worse than that of average criminals, and, in fact, much higher than that of psychotic patients who can complete the test. C—'s worst fault was his disregard of instructions through lifting the pencil before the test was completed.

On the first examination, 12 weeks after lobotomy, his maze test ability was shown to have deteriorated markedly. He showed the same careful approach as before, but after succeeding in the five- and six-year designs, failed completely in two trials in the seven- and eight-year tests. The test was continued and he failed at the nine-year level, succeeded in the 10-year on two trials, then failed the 11-year maze in the allotted two trials. The test age was 7 years, *IQ* 50, a loss of 4 years or 29 points in test quotient.

The test was repeated again on July 16, 1942, about a month later, when it was confidently expected that, as is usually the rule with the Maze, practice effects would be apparent. These were, however, negligible in amount.

Again the five- and six-year mazes were compassed without special difficulty, but two trials were required for the seven-year test with complete failure on the higher tests. In each of these tests he repeated the previous error. His improvement over the previous examination amounted to half a year. The qualitative scoring was not applicable as he did not continue far enough in the test to admit of such a scoring.

The third testing on November 19, 1942, eight months after operation, yielded equally extraordinary results. Again the five- and six-year tests were passed on single trials, but he failed in two trials on the seven-year test, got the eight-year in one trial, but failed completely in the nine- and ten-year designs. The final quantitative score was, therefore, only seven years.

Any normal child of seven or eight with this amount of practice would certainly pass at about a 12-year level, so that C—'s continued failure to adjust to such a relatively easy task is the more remarkable.

In each instance the difficulty seemed to be one of division or alternation of attention between drawing carefully within the guide lines and choosing the right direction in which to proceed.⁶ Even when the test was studied beforehand, it made very little difference in the results. The goal was soon lost to view and failure followed. The patient did not show the normal concern over his mistakes although he worked most carefully.

On the 19th of February, 1943, C— was again given the Maze, actually the fifth application of the test. On this occasion the five-, six-, and seven-year tests were passed on the first trial, with complete failures in the eight- and nine-year designs. It would seem quite impossible for C— to make any adequate adjustment to this test, even on repeated attempts.

In view of the steady improvement in the Binet since the operation, this inability to plan and execute a practical task such as the Maze is in striking contrast, and if confirmed in other instances, would seem to be related to disturbance of prefrontal lobe functioning, or to impairment of the organization of the brain as a whole due to the operation.

About the time of the first postoperational testing, the examiner had an opportunity to observe C— playing two games of checkers. Here he displayed considerable skill, making his moves very rapidly and with a minimum of indecision. He lost the first game but in the second he con-

⁶This conclusion has been partially confirmed. Lobotomy patients who made good scores in the Maze subsequent to the operation made errors when asked to mark the course with a continuous wavy line.

trived a clever trap by which he made a net gain of four pieces, thus winning the game. From this it was evident that there was no considerable loss of planning ability on the perceptual level.

It must be remembered, however, that the Maze and the checkers situations are dissimilar in one important feature. In checkers there is no need to alternate attention between dissimilar activities. Once the choice of moves has been made, nothing is required except the muscular effort of shifting the piece. A minimum of time elapses between decision and action. In the Maze, however, the patient must divide or alternate his attention between the two dissimilar activities of drawing the lines and anticipating changes in direction according to plan. There is, therefore, a temporal factor involved, and the more careful the drawing or the longer the line to be drawn, the greater time is interposed between decision and execution.

In Jacobsen's experiments with lobectomized animals, the importance of this temporal factor has been demonstrated. With human subjects a similar effect has been observed. Nichols and Hunt report that their case showed a drop in performance in the *Knox Cube Test* when delays of 20 seconds were interposed between presentation and reproduction, although these authors remark that "further study will be necessary before we can affirm a deficit of temporal integration such as Jacobsen found in lower primates" (9, p. 1075). In view of their reported findings, this seems to be a very cautious statement.

B. CASE No. 2

The second case was that of R—, a white man, 38 years of age, who was diagnosed as dementia praecox, paranoid type.

R— came to the Territory 26 years ago from California, first became mentally ill about 1931, and was admitted to the Territorial Hospital for Mental Disorders on August 5, 1939. His general physical condition was satisfactory except for bilateral chronic deafness of mixed type. Blood and spinal fluid serology, urine, and blood count were normal.

R— was the only child of an alcoholic father and a somewhat unstable mother, who was never able to get along well with other people. The mother had to do dressmaking to support herself and child. She divorced, remarried, came to Hawaii with R— when he was 13, and later divorced the second husband.

R— graduated from high school at 19. He held first one job and then another as clerk or salesman, losing a number of opportunities for advance-

ment because he ordered other employees about too much, while he himself frequently lost his temper and refused to take orders from his superiors.

He was married at 24. His mother resented his wife and blamed her for most of the patient's troubles. The history is suggestive of sexual maladjustment in this marriage.

The onset of definite psychotic symptoms seems to have been in 1931, following an appendectomy and subsequent operations for the relief of adhesions. The patient believed that people were outside his window looking in and checking up on him.

In 1935, he complained of pains on the top of his head and had X-rays taken. In 1937, he had a vasectomy. His deafness, which had been coming on for 14 years, apparently contributed to the development of paranoid ideas. These centered about his wife, who, he thought, was being killed or assaulted. He also had delusions about his testicles being removed and others substituted. Just before his commitment in 1939, patient went to the Bishop Museum and ordered everyone out, saying that the place now belonged to him.

During his stay in the Territorial Hospital, there was no appreciable change in his mental condition. He continued to entertain the same set of paranoid delusions and frequently reacted to them with violence. On a number of occasions he attacked patients and employees who he thought were conspiring against him. On one occasion he dashed wildly down the road to rescue his wife because he believed she was being raped in a cornfield near the hospital. He frequently demanded his release so that he might get a lawyer and investigate the queer things that were going on outside the hospital in connection with his wife and children. He frequently experienced auditory hallucinations and heard his private affairs discussed over the radio.

R— was therefore recommended for electric-shock therapy. When this failed to benefit him, he was approved for lobotomy. Encephalogram done December 10, 1942, was normal and showed no contraindication to operation.

Bilateral prefrontal lobotomy was performed by Dr. R. B. Cloward on January 21, 1943, according to the technique described above. A post-operative X-ray showed the trephine opening on the right side directly over the coronal suture. The subcortical incision outlined by the lipiodol on the right side appeared to follow the normal pathway, extending to within 0.5 cm. of the mid-line. The plane of the incision extended obliquely forward. On the left side the trephine hole was made 0.5 cm. posterior to

the coronal suture and lay along the edge of the middle meningeal groove. The subcortical incision as outlined by the drops of lipiodol appeared to extend slight forward, and to within 1.0 cm. of the surface of the brain.

His postoperative behavior was characterized by slowness and dullness of thinking, also euphoria, restlessness, rectal and vesical incontinence. Apart from a general slowing up after the operation, he did not exhibit any marked mental changes. He looked brighter, felt more cheerful, was much more coöperative, and did some work in the wards. He was quite sure he was cured and talked of going home.

During February his behavior was recorded as meticulous; he was slow in his reactions, lacking in initiative, restless, facetious at times, with increased appetite. He talked a great deal about going back to his wife, who, however, had divorced him a long time previously. He refused to recognize this fact, or had really forgotten it. In March, there was considerable euphoria, with slow reactions, playfulness, facetiousness, and increased appetite. At that time his condition as regards delusions, etc., was definitely improved.

In April there was, however, a marked retrogression. He was confused, anxious, restless, with some euphoric phases, succeeded by worried, apprehensive states. He believed that it was necessary for him to go home to investigate various matters including his divorce. He was very secretive about what was troubling him, saying he could not talk till he had consulted his lawyer. There were radio broadcasts referring to him and his troubles. People were again manipulating his organs, removing them and replacing them by others. Euphoria was much less apparent than formerly. He spoke of apparatus built into the hospital, but believed it was being used for his benefit.

His behavior on the ward became more troublesome; he kissed the nurses, and resented any objections on their part, or reproofs from the doctors. His delusions seemed to regain all their former force and he had to be transferred to a closed ward where he could be more closely supervised.

At a staff conference on April 30, 1943, R—'s condition was considered "unchanged." Since that time, however, there seems to have been some improvement.

This man was examined psychologically twice; in the first instance on July 16, 1942, about six months prior to the lobotomy. He was a high school graduate and he passed the Binet at a very high level, succeeding in most of the superior adult tests. He had an excellent range both in vocabulary and in immediate memory for digits. His chief difficulties were in

interpreting proverbs and in seeing essential similarities between processes such as farming and manufacturing, melting and burning, etc. His Binet *IQ* worked out at 131.

In the Maze test he did not score nearly as well. In one test his performance was somewhat marred by impulsiveness; he required three trials in the 14-year test. His test age was 14 years, test quotient 100. His qualitative score was 16, which is slightly better than the average of high school graduates in Hawaii.

The second mental examination was given on February 19, 1943, six weeks after the operation. In the Binet the most striking loss was in reversed digit span. Whereas he could formerly repeat six numbers reversed, he was now reduced to a four-digit span. In repeating digits forward, the loss was not so marked, dropping from a nine- to an eight-digit range. It should be noted that there is a temporal factor involved in the reversed digit test. *R*—'s vocabulary was also considerably reduced, from 32 words of the Terman-Merrill list to only 23. His explanations and definitions tended to become involved and repetitious. There was also a tendency to stray from the point, which was particularly noticeable in his interpretation of proverbs. It was noticed that he gave all his explanations a personal twist or reference. His score was 17 years, *IQ* 113, a deficiency of 14 points compared with the first examination.

In the Maze test there was an even more marked loss in ability. He did the tests very well up to and including the 11-year design and then failed in four trials on both the 12- and 14-year-tests. Thus his score was only 11 years and his test quotient 80,—a drop of 20 points below his preoperational level. His qualitative score remained at 16 error points.

His reactions while taking the Maze were very peculiar. He accompanied each effort by a stream of inconsequential comments and verbal self-admonitions, to which, however, he failed to give heed in action. Examples of his comments were:

"They say you must follow your nose—that's the way to get out."
"I'll follow my nose again." "This should be easy; a man ought to get out of this." (After an error.) "I'll look at the test first this time. I'll get out this time. I went in here before—well, I'll try it again."

The worst feature of the performance was the repetition of identically the same error. He seemed to have lost, at least temporarily, any capacity to profit by his mistakes or to use a critical attitude in readjusting his methods.

He was apparently quite satisfied with an inferior performance, and showed little concern over mistakes.

The patient's behavior during the testing was somewhat obtrusive. He was needlessly helpful, bustling round assisting the examiner to get seated, etc. He was euphoric, with little concern over his failures. At this time, however, his delusional ideas seemed to have completely disappeared so that the changes due to the operation were felt to be in the nature of *not* improvements. A week later, however, the delusional ideas seemed to have begun to return, though they had lost some of their dynamic values. Unfortunately, the retrogression continued at a more rapid rate as can be seen from the preceding report of his behavior in hospital.

C. CASE No. 3

The next case provides a contrast to the others of this series mainly because of the small degree of intellectual change following the operation. N— was examined first on November 23, 1942. He was then 39 years of age and had been committed to the hospital as insane following the killing of his wife by stabbing. The evidence showed that N— had been definitely paranoid for some time prior to the tragedy and had consulted various doctors concerning his condition. The hospital record is summarized hereunder:

This patient, N—, of Portuguese-Hawaiian ancestry, was sent to the Territorial Hospital on April 2, 1940, on a court order to determine his mental responsibility for murdering his wife on March 26, 1940. He had finished the fourth grade in school and had worked as a boiler-maker at the drydocks and with a contractor on construction.

In March, 1939, he had consulted a physician because he was then mentally disturbed and nervous on account of his experiences in a strike, of which he was a leader. After the strike was settled, he felt that his fellow unionists were against him. He also believed that they thought him mentally incompetent. This physician thought he was developing a paranoid type of mental disorder but did not believe him dangerous at that time. A year later, N— killed his wife by stabbing her. On April 12, 1940, a board of psychiatrists reported to the judge that he was suffering from dementia praecox, paranoid type, at the time of the killing and that he was not, therefore, mentally responsible. The charge was "nolle prossed" and the patient committed to the hospital.

On admission, his physical condition was apparently normal, including blood and spinal fluid. Mentally, he was coöperative, speech was spontaneous

and fairly coherent, though he was very talkative about his persecutory delusions. He claimed that he saw the devil and his wife together and that she had tried to *kahuna* him by putting menstrual blood in his coffee. (This may have been a survival of primitive beliefs of Hawaiians.) Sensorium was clear; he was correctly oriented as to time, place, and person. There were some auditory and visual hallucinations.

The patient had some of the most interesting though unsystematized ideas of reference and persecution ever heard from a single individual. Everything his wife did, even the way she set a milk bottle on the shelf, had an inimical design. He believed that she was working harm against other members of his family as well.

He had taken her out about a month before the murder with the intention of killing her, but changed his mind. He had a queer feeling in his head as if something were shaking inside it. His wife's actions were like Frankenstein's. She could always hear what he was saying no matter where she was. He claimed to have a very vague idea of having killed his wife, but could remember none of the circumstances.

If he had murdered her, it was because she refused to remove the spell she had cast on him. She was a mystery woman and could influence people by electricity. He wondered if she was killing people. To him, the story of the attack on his wife was unreal. He believed she was hiding somewhere. He gave a very confused account of things involving hypnotism, clothes and bottles, shoes and *kahunas*, etc.

During his further stay in the hospital, N— was somewhat restless, garrulous, complaining, continued to misidentify persons, thought he saw his wife, lacked insight into his condition, was at times quite bewildered, had grandiose ideas about his strength and sexuality. He was anxious to leave the Territory because he thought that would settle his troubles. On September 3, 1942, an encephalogram was done and found normal. Lobotomy was then recommended and approved.

The operation was performed by Dr. Cloward on December 3, 1942. Post-operative X-rays showed the trephine hole on both sides of the skull slightly anterior to the coronal suture on the right side. The lipiodol showed that the incisions through the white matter of the frontal lobe measured 5 cm. deep, and 5 cm. from vertex to the floor, the inferior incision reaching within a few mm. of the roof of the orbit on both sides.

The day after the operation, the patient said that he felt fine, was very friendly and talkative, felt no electricity going through him, urinated with-

out difficulty, wanted to know when lunch was to be served because he was hungry, smoked cigarettes, and read a magazine. He had no rectal nor vesical incontinence at any time. He was very cheerful. On December 5th, he wanted to know how much the tumor weighed that the doctors took out; he said he felt some electricity through him but not so strong. His mind was getting better and he wasn't thinking of things as he used to; he was resting well, and had no problems and no complaints. On December 9th, he was planning to go to the union office and register as a seaman to take a boat to Portugal. He said that he had now gone through a new test, and it was about time for him to get out of town.

All this time he seemed to be very cheerful, coöperative, helping other patients. No abnormalities were noted, except that he was observed December 15th to be somewhat silly and full of wisecracks. He liked to fool and tease the attendants, was very jolly and facetious. He was a willing helper about the wards. December 20th, he again felt electricity through his body. December 21st, he remembered what he did to his wife, but stated he didn't believe it himself, thought she was drugged. He told the doctors the same thing but nobody believed him. He showed no tendencies to irritability nor anger. December 23rd, he went to church, behaved well, took prayer book, prayed before it, read it. December 26th, he was restless, depressed, worried, paced the hallway, said someone was putting the pressure on him, couldn't explain who. December 30th, he was still restless. He was cheerful and congenial most of the time; occasionally, however, he got into arguments with other patients. December 31st, he was depressed and discontented one moment; joking, having a lot of fun the next.

Notes for the month of January showed euphoria, lack of initiative, laziness, restlessness, facetiousness, and at times playfulness. During the month of February, euphoria, occasional restlessness, playfulness, and attempts at witticisms were the outstanding features. During the month of March, euphoria, at times playfulness, witticisms, and increased appetites were recorded. In the month of April, euphoria, witticisms, and increased appetite were noted.

At the present time, June 1, 1943, the patient is working in one of the hospital kitchens. He is euphoric nearly all the time with marked playfulness and wisecracking, witticisms, causes no trouble, is almost never depressed. He still feels the electricity through him occasionally. A few days ago he told a woman attendant to get away from him, that she was putting electricity through him.

He still desires to get on a boat and get out of the Territory, but does not seem to be irritated nor depressed when he realizes that this cannot be done. He is somewhat dull, but is doing fairly good work in the kitchen. He rarely talks about his wife; in other words, the whole affair does not seem to cause him a great deal of worry at the present time.

At a conference on April 8, 1943, it was felt that N— was definitely improved.

At the time of the psychological examinations he talked about various religious obsessions. He believed that his father had the gift of prophecy, could foretell the weather and had predicted that he, N—, would some day be at the hospital for insane. The patient complained that he occasionally had very disturbing visions, but explained carefully that they were not visual in character. They were more in the nature of anticipations of a set of events in which he was, willy nilly, to be a participant. That was why he believed he might be under the spell of a *kahuna*, or some similar malign influence.

In his preoperational examination the mental level by the Binet was 12 years 6 months. His chief failures were in repeating digits backwards (only a three-digit span), and in the association tests in which he gave 25 words in the first minute and then lapsed into sentences describing his relations with the doctors at the hospital. He could not interpret the absurd pictures correctly but gave good definitions of abstract words and showed good memory for designs.

In the Maze test he made an excellent showing with only one unsuccessful trial at the 12-year level. Qualitatively, however, his response was not so good. There was considerable evidence of nervous tension and he tended to disregard instructions. The error score was 55, which is just about the criminal average.

In the postoperative examination in February, 1943, there was little observable change in performance. Again failure was recorded in the free association test. He began to give sentences instead of single words and then refused to go on, declaring that the test brought back feelings of mental confusion from which he had previously suffered. He managed to repeat four digits backwards on this occasion and his final Binet score was 12 years 9 months.

He passed all the Maze tests on the first trial and thus earned a test age of 15 years. His qualitative score of 29 was considerably better than on the previous examination, although he was indecisive at first and seemed

to have great difficulty in getting started in some of the easier tests. However, as he progressed in the series he gained confidence and improved his responses. In a second application of the maze, when asked to mark his course with a continuous wavy line, he failed the nine-year test completely but adjusted better in the higher tests. This innovation in test procedure was introduced to measure his ability to divide attention between the mechanics of maze tracing and planning his course.

Emotionally, there seems to be some general improvement. He is still somewhat confused in his recollections of the events leading up to his commitment, or at least he professes partial amnesia. It was noticed, however, that in later interviews he was willing to carry the story much closer to the actual assault on his wife. Previously, he would proceed with the narrative up to a certain point and then profess forgetfulness for all following events.

Perhaps the most outstanding feature in *N—*'s behavior is an apparent lack of appreciation of the gravity of his situation, a characteristic also of Brickner's case. He insists that the trouble between himself and his wife was purely "a family affair," and it had nothing to do with the government of the Territory, and that he should be released so that he could leave the country and make a new start elsewhere.

As regards *N—*'s general reactions, there is considerable improvement noticeable since the operation. Apart from his insistence on an early release, he seems to be well adjusted. He is employed in the kitchen and though he says the work is uninteresting, he makes no attempt to be assigned to more interesting work. Altogether the operation, as was previously indicated, seems to have had less effect on *N—* than on any of the others, so much so that the question was raised as to the exact *situs* of the operative lesion. Dr. Cloward states that the technique was somewhat different in *N—*'s case. This patient has a very round head and so the surgeon made certain compensatory operative adjustments, which may easily have resulted in the incision following a somewhat different plane.

The atypical results may have been due to this fact. Another suggestion is that the incision may not have approached as close to the cortex as in the other cases. It is a reasonable assumption that the less the operative lesion approaches the cortex, the less the intellectual deficits will prove to be. In heads of varying shapes and sizes, the structural lesions may easily vary in relative position and even in extent. A slight difference in the approach of the cut to the brain surface may thus quite conceivably make a large

variation in the psychological effects. On this point there is an urgent need for more experimental evidence.

D. CASE No. 4

The fourth case was that of Mrs. M—, who gave her age as 64 years when she was examined on January 6, 1943. She had been diagnosed as a case of involuntional melancholia and had various obsessions about certain numbers and colors which she must avoid. The clinical report follows.

The patient, M—, was a widowed Caucasian woman, 60 years of age, who had been admitted to the Territorial Hospital on October 15, 1940. She gave a history of mental illness since 1939, at which time she was hospitalized at the Mental Health Clinic at Queen's Hospital for three months, and later on, for two months in 1940.

The commitment papers stated that she had suffered from depression, excitement, and suicidal tendencies. She was mentally confused, delusional, and extremely anxious about her mental state. She had been employed by a cable company as clerk. Reports from the hospital stated she was talkative, with flight of ideas. She was finally discharged from the hospital to a rest home. At the time of her second admission to Queen's Hospital, she was talking incessantly and was very depressed. Shortly after her discharge, her mental disturbance had increased and she threatened to commit suicide by opening a blood vessel with a pair of scissors. She thought she had misappropriated money from the cable company and that her pension would be stopped. The Mental Health Clinic reported that at times she could not recognize people, was disoriented, and showed memory and judgment defects. She was thought to be an old psychoneurotic, with compulsive and hypochondriacal ideas. Although rather old for that group, she was believed to belong with the involuntional depression group.

On admission to the Territorial Hospital she was quiet, coöperative, but somewhat depressed, retarded, anxious, and apprehensive. Her sensorium was clear and intellect seemed well-preserved. She was much worried about financial matters and her supposed theft from the cable company but denied any suicidal ideas.

One of her special obsessions had to do with colors and numbers that were symbols affecting the welfare of herself and her brother in England. She was constantly worried about how many slices of bread she ate, the number of the locker where she hung her clothes, the position of her feet in bed, etc. No hallucinations were elicited. She showed no evidence of

the memory and judgment defects characteristic of arteriosclerotic mental disorders. Her insight and judgment were only fair.

Her physical condition was generally satisfactory for one of her age. Blood and spinal fluid were negative. Retinal examination showed minimal arteriosclerosis. Encephalograms showed moderate generalized cortical atrophy of the left frontal lobe.

Because of the constant and distressing nature of her delusions and obsessions, and because of the splendid results obtained by others in such cases, she was scheduled for lobotomy in spite of the psychologist's recommendation against operation. She fell and broke her hip in April, 1942, and so the operation was deferred until January 14, 1943.

Immediately after operation, she was still worried with compulsive ideas and obsessed about numbers, colors, etc. In the next two weeks her reactions became less retarded, her depression lifted, and she began to gain weight. She was still troubled with vesical incontinence. There was also lack of initiative, somnolence, and slowness of thought. The following month (February), these symptoms continued with, however, euphoric intervals.

In March, there was at first a marked improvement. The patient was friendly, neat, helpful, and pleased with the colors of her dress. Then after some trouble with another inmate, who struck her, she became hyperactive, noisy, rambling, and incoherent. There was flight of ideas with delusions, anxiety, meticulousity, irritability, emotional lability, slowness and indecision, lack of initiative, masked faces, tantrums, and increased appetite. In April, there was no change so that at a staff conference she was declared to be worse than before operation.

The Binet examination showed extreme irregularity, the scattering of failures and successes extending all the way from the 10-year level to that of Superior Adult III. She was unable to interpret the absurd picture at the 10-year level nor could she repeat six digits in order, yet her vocabulary score was 38 out of the Terman-Merrill list of 45 words. As a matter of fact, she succeeded in all the verbal tests above 12 years and failed in all the non-verbal questions. Her successes were understandable as she had possessed considerable literary ability. Her failures could only be ascribed to a process of mental deterioration.

In the Maze test she was extremely hesitant and fearful. Even the simplest mazes presented to her a most serious problem. The single instruction that she must not cross any lines filled her with extreme anxiety. As though to remind herself of the risks, she repeated over and over again,

"*I dare not cross a line.*" She failed the six-year test, got the seven-year year on the first trial, and failed completely in the eight- and nine-year tests. Qualitatively, her performance was most inferior.

The psychologist's recommendation was against lobotomy on the grounds of the patient's age and existing mental deficiencies. As lobotomy adversely affects planning capacity, which was already defective, it was thought that operation might make matters worse.

The postoperative examination on March 8, 1943, showed considerable loss of intellectual ability. The patient made a complete failure on the 10-year "free association test." She seemed to lack initiative, being unable to pass from one associative sequence to another. Her vocabulary was still superior (35 words), but she was unable to explain proverbs, give essential similarities, or the differences between character and reputation, etc., all of which were tests previously passed.

She approached the Maze test with considerably less anxiety than on the previous examination. She was no longer as fearful of making errors and seemed much better satisfied with her performance. Nevertheless, her performance was actually worse than before. She earned only five-year credit and in the higher tests repeated the same errors over and over again. There was no planning capacity evident. The operation had apparently resulted in alleviating her anxiety state but there was a tendency to adopt a more aggressive attitude, which rapidly took the form of manic excitement.

E. CASE NO. 5

The next case to be reported is that of a woman, Mrs. T—, 39 years old, who had been diagnosed as dementia praecox, catatonic type. She had entered the hospital in 1933 and was then reported to be noisy, disoriented, with flight of ideas and some delusions. Lobotomy was performed on January 25, 1943. The following is the psychiatric report.

Patient T— was a Portuguese woman, 39 years old, separated or divorced. At the time of her commitment to the Territorial Hospital in 1933, she was 29 years old. A sister has been a patient of the hospital since 1936. In 1941, the patient's daughter, 15 years old, began to show signs of delinquent behavior.

The onset of the mental disorder was placed at three days prior to commitment and was allegedly precipitated by some family difficulties. The patient was disoriented, flighty in her speech, noisy and destructive. She displayed many peculiar bizarre mannerisms. She believed that her food was being

poisoned and that she was to be done away with. Her general physical condition was normal, and serology negative. A diagnosis of dementia praecox, catatonic type, was made.

At times during her hospital stay she was seclusive, uncoöperative, did no work. During most of her stay, however, she continued to be restless, hyperactive, noisy, and on occasions belligerent. At all times she was destructive and displayed very peculiar antics and mannerisms. She was facetious in response at times. Her speech was incoherent much of the time, and at times contained neologisms. She was definitely resistive, destructive, and belligerent during the most of these 10 years.

Because of her continued restlessness, hyperactivity, belligerent and combative conduct, confusion, disorientation, inattention to her person, it was thought advisable to do a lobotomy on this patient. Encephalogram July 9, 1942, showed no abnormality which might contraindicate operation.

Immediately after the operation, she seemed much slowed up in all her thinking. Her actions showed a definite lack of initiative. She exhibited a certain amount of somnolence and emotional blunting. She also had a tendency toward procrastination. She seemed at times to be disoriented and to be suffering from amnesia.

There was noted, however, at times since the operation a mild euphoria. This, however, has not been the situation most of the time. Her whole general conduct has suggested emotional blunting, and apathy with a superficial pleasantness and cheerfulness. Her appetite recently has been increased. She has been facetious on occasions; slowness and dullness of thinking, some amnesia and disorientation are noted at times.

However, on the whole, this patient is very quiet, coöperative, has gained in weight, is a useful worker around the ward, has adjusted herself very well indeed. At the staff conference, April 29, 1943, she was considered improved.

In the preoperative examination, the patient was found to be very unresponsive, although success in the tests which she would attempt seemed to indicate a greater amount of ability than was generally apparent. She was able to give change correctly, to copy a diamond, and repeat 5 digits. No mental age was assigned. The Maze test could not be applied, the patient showing no interest nor effort. The psychologist reported that this was a case in which there was nothing to lose and something might be gained through the operation, especially in the direction of improving her general adjust-

ment to the extent of rendering her capable of doing some work in the ward, even though at a low industrial level.

The second examination was given on April 1st, about 10 weeks after the operation. Though the patient was still withdrawn to the extent of seclusiveness, she made a better attempt at the Binet test. In addition to the tests previously passed, she succeeded in repeating three digits backwards, six digits forwards, giving the days of the week, opposite analogies, and also passed two tests involving money problems at an 11-year level. The free association test she would not attempt.

Though she previously would not try the Maze test, she now succeeded in obtaining a nine-year score. She failed in the nine-year test but succeeded in both the 10- and 11-year tests on the second trial. There was little ability to profit by experience, as she repeated the same error. Qualitatively, her performance was extremely inferior. She persistently disregarded instructions, her lines were very irregular, with many crossed lines and cut corners. Her qualitative score would be well over 100. The fact, however, that she would now attempt the test and persevere in its performance was in such marked contrast to her previous reactions that it indicated considerable improvement. However, this case, as well as the one last cited, illustrates the difficulty in obtaining comparative test reactions since the former failure to attempt the test precluded any opportunity of judging the preoperative level of ability. Experience in the examination of psychotics, especially the schizophrenic, proves that their level of ability is often underestimated because of the fact that they are inaccessible in the testing situation.

F. CASE No. 6

The sixth case, K—, a woman of 56 years, is included in spite of the fact that no preoperative examination was given. The psychologist saw the patient for the first time two weeks after psychosurgery. Appraisal of the behavioral effects of the operation will again be given by Dr. Kepner.

This patient, K—, was a Polish-Jewess born in Poland, 47 years old, in the Territory 11 years. She had apparently always been unable to adjust, and had wandered about living by her wits all her life. She had been diagnosed as dementia praecox with syphilis in one mainland psychopathic hospital, and general paresis in another. She was committed to the Territorial Hospital May 2, 1936, because she was quarrelsome, believed she was being persecuted by various social organizations, and actually attacked some of their employees. She went about preaching religion, made

a general nuisance of herself by begging from and calling on persons she hardly knew. She attempted to see the Governor on occasions.

On admission to the Territorial Hospital, she was quiet, orderly, interested in her surroundings, and more or less rational except on the subject of her persecutions. Her physical condition was satisfactory. Blood and spinal fluid were repeatedly negative. A diagnosis of dementia praecox paranoid type, was made in this case.

She soon became a difficult problem to handle because of her eternal complaining about her incarceration and neglect by the doctors, her lying and trouble-making, her actual physical fights with other patients and employees. Numerous attempts were made to place her in the community, or return her to Poland, but these were unsuccessful. In the meantime, her behavior in the hospital continued about as usual. She blamed the doctors for persecuting her and keeping her in the hospital. A place was located for her in September, 1940, but she refused to take it because it looked too much like work. Patient was finally paroled July 1, 1941, drifted hither and thither in town, sponging on religiously inclined folks, making herself a general nuisance. She refused to cooperate with people she was living with, slept on the floor instead of the bed, etc. She was glad to get back to the hospital, said it was too hot to do work in town, and people didn't treat her right anyhow.

Because of the severity of her mental disorder, lobotomy was recommended. Encephalogram April 17, 1942, showed moderate generalized cortical atrophy, more marked in the left hemisphere; this was believed not to contraindicate the operation.

Lobotomy was done April 10, 1942. Patient was cooperative after operation, said she felt well, had hiccoughs and involuntary urination, was very much slowed up mentally, somewhat confused, played with strings, tied a rubber around her finger until it became blue. She was very much slowed up in action, very lazy, had difficulty in getting out of bed and in doing things in the way of self-help or work.

After some time she became more cheerful, more cooperative, but this didn't last long, and she was soon transferred to a more restricted ward.

Patient was paroled August 8, 1942, and returned after only three days because she failed to make an adjustment.

Her behavior after return was essentially the same as before. She was flighty, talkative, tactless, confused at times, full of obsessions and ideas of reference, some worry, nervous tension, suspiciousness, hostility, emotional

lability, increased suggestibility, with a general slowing of action, indecisiveness, lack of initiative, some restlessness, aggressiveness, and agitation, sarcasm, occasionally obscene behavior, increased appetite. Indigestion, of which she complained for years, was still present.

Because of her failure to improve and her difficulty in adjusting here, and the fact that her lobotomy cut, according to Dr. Cloward, had not been so deep as it might have been, she was reoperated on on March 18, 1943. She went through this operation well with no change in her behavior immediately after her operation nor subsequently. She did not, after the second operation, display any particular confusion, incontinence, etc. Her present condition is definitely unimproved.

The least significant changes in mentality were apparently in the use and understanding of language. In spite of the fact that she did not arrive in America from Poland until she was 13 years of age and had had to learn English since that time, she possesses a vocabulary of a superior adult level. She could not criticize the absurd pictures, her comments being irrelevant or inconsequential. In the free association test she could give only 22 words in three minutes, and in the drawing designs from memory, she could not get started without smoothing the paper, looking at her nails, etc., and then drew quite at random. These reactions are quite typical of many lobotomy cases as described by Freeman and Watts, and by Lyerly.

In the Maze she showed very inferior planning ability. She understood and obeyed the directions for the test and succeeded in the five-year test. In the six- and seven-year tests, however, she made the most obvious errors in planning her course, giving her attention mainly to the drawing of the lines.

The second examination on March 8, 1943, about 10 months later, showed considerable improvement in the Binet. In the free association test, instead of 22 words she was able to give 51 in three minutes. She also interpreted proverbs correctly, explained similarities between farming and manufacturing, etc., at a superior adult level. Language ability, therefore shows no deficits. As with some other lobotomy patients, however, there is decreased flexibility of response; she is still unable to repeat four digits backwards, though she has a 6-digit forward memory span. As before, she fails to reproduce designs from memory.

The Maze test showed a slight improvement on her previous attempt. She passed the five- and six-year tests on the first trial, the seven on the second, but failed at the nine- and ten-year levels. Thus her score is now $6\frac{1}{2}$ years, still a striking deficiency in comparison with her Binet performance. As

before, this indicates very inferior planning capacity; she exhibited the same inability to learn from experience, repeating the same errors on successive trials.

Though we have no preoperative data, there is good reason to believe that this wide gulf in performance between a superior adult level in language tests and a six-and-a-half-year level in Maze performance is a consequence of the operation.

Unfortunately, in this patient the Maze results reflect the social inadequacy much more accurately than does the higher Binet score. In spite of the improvement in the second Binet examination, her condition after the operation has so far not changed materially.

G. CASE No. 7

B. K—, the seventh patient studied, has had an interesting background, having been known to the Psychological Clinic of the University of Hawaii for a number of year. He was first examined in 1927, when a pupil at a Honolulu elementary school, by Dr. Bernreuter. At that time he was 11 years old and passed a Binet test at a 7-year level, *IQ* 64. His Maze score was 6½ years, *IQ* 59. On the basis of these results, Dr. Bernreuter declared him to be a high grade defective.

Our next contact with him was after he had been committed to the Boys' Industrial School on charges of burglary. The *Otis Self-Administering Test* was applied and he scored at an *IQ* level of 46. In the *Pintner Non-Language Test*, he did better, earning an *IQ* of 60. The Maze test age (second application) was 11½ years, *IQ* 82. This examination was given in 1934.

Three years later, he had become an inmate of the Oahu Penitentiary, and at that time his Binet age was 9 years 10 months, *IQ* 67. The third application of the Maze showed considerable practice effects, but not quite so great as might have been expected. His score was 13 years, *IQ* 93. The psychologist (Porteus) reported him to be extremely dull and mentally unstable, and "a very poor risk for community life." This latter prediction was based on a criminal index of 20, a means of evaluating the past delinquent record. His family history was very unfavorable. Two sisters were feeble-minded and one of them was delinquent and venereally infected. The father was reported to have died insane. Shortly after this examination the patient was transferred to the Kaneohe Hospital under circumstances described in the following summary of his hospital record.

Patient *K—*, was a Chinese-Hawaiian man of 22 years, first admitted to

the Territorial Hospital January 19, 1939, from Oahu Prison where he had been since 1934 serving a sentence of 20 years for burglary in the first degree.

His father had died in the Territorial Hospital in 1934 of chronic alcoholism and pulmonary tuberculosis. His mother had died years before, cause not known. The patient had been in the Boys' Industrial School for many years, and after his release had three convictions for drunkenness and one for petty theft. Following these, he had served a sentence for first degree burglary, was paroled, and was subsequently convicted on another burglary charge. His troubles in prison had been disobeying orders, attacking and threatening other inmates, using abusive and vulgar language toward the guards and inmates. The prison physician reported the following:

On January 11, he claimed to have seen the picture of an old man and couldn't sleep. On the night of the 12th, he banged his head against the bars of his cell. On January 13th, he also saw women's backs; they were fully clothed. He said his mind was no good.

On admission to the Territorial Hospital, he was depressed, quiet, orderly, coöperative. He said his head was no good. He said that he hit his head against the prison bars believing that it would help him and would help make his head go straight.

Examination done January 20, 1939, showed that he was dull, retarded, coöperating well but slowly. Speech was coherent but not spontaneous. He was somewhat depressed, but said that he was not worried. He had been in the Industrial School for many years, according to his story, and went on parole. He became drunk and had a fight. For that reason he was sent to the territorial prison, whence he was transferred to the hospital. He admitted hallucinations as mentioned above. He heard an old man laugh at him every night, saw a woman's back. He could not identify either person. He knew that this was the Kaneohe hospital for insane. He gave the date as January, 1939, but did not know the day of the month nor the day of the week. He knew his name and remembered that he had come in the day before. He said that his father had died here in 1934.

Although *IQ* was given as 67, it appeared to be somewhat lower, judging from the preliminary examination, in view of the fact that he had started school early and finished the fourth grade at 14 years of age, and could not multiply 2 by 2 or 2 by 6. He believed that his mind was "off," but didn't know just why. His general physical examination was essentially normal. Blood Wassermann, Kahn, and spinal fluid examinations were negative, as were urine, stool, and sputum examinations.

At a staff conference February 21, 1939, a diagnosis was made of mental deficiency with psychosis. On June 15, 1939, he was returned to the Oahu Prison as recovered from his psychosis. His mentality was still subnormal, of course, but he had good insight into his condition and was in good general health.

Patient was readmitted to the Territorial Hospital April 14, 1941, again from the Oahu Prison. The warden stated that he had appeared to be normal for some time after his return from the hospital. Shortly after receiving a treasurer's warrant for 20¢ sometime in June, 1940, he came to believe that the amount was \$20,000 instead of 20¢, and kept asking that this money be sent to him. At other times, he would say that the money was stolen from him and accused different ones of keeping the money.

At the time of his readmission, he recognized the fact that he had been in the hospital previously. He was cooperative, responded well, slept well, and made no complaints. During the first few days after his readmission, he sat about by himself, somewhat depressed. He was correctly oriented as to time, place, and person. Memory and retention were good. Judgment and insight were generally fair. He believed that he had been returned here because the deputy sheriff's wife wanted to take his \$20,000 away from him. He did not believe that he was insane. His physical condition was still satisfactory except for a bilateral chronic purulent otitis media. A diagnosis was again made of psychosis with mental deficiency.

During his hospitalization he was frequently in trouble—irritable, aggressive, and combative with other patients. He was untrustworthy and had to be kept in a closed ward to prevent his escaping. He was delusional and noisy at times and indulged in lewd speech and gestures. Because of his long-continued failure to adjust, he was recommended for lobotomy. Encephalogram done May 15, 1942, showed a slight cortical atrophy, with a possible deep subcortical scar in the right rolandic area and a moderate dilatation of the frontal horns of the lateral ventricles. These findings were believed not to contraindicate the operation. The patient himself agreed with the staff in regard to the operation and wanted to "get fixed up."

On May 29, 1942, bilateral prefrontal lobotomy was done by Dr. Cloward.

After the operation he was somewhat confused—pretended to be using a telephone, removed dressings from his head, decorated his bandages with flowers, giggled to himself, made facetious remarks to the nurses. Involuntary defecation and micturition were present. On June 4, he was out of bed, playing with a toy gun and pretending to be a cowboy, playing with

a yoyo. He sat about on the toilet much of the time, had to be urged to move, and was much retarded in all his actions. He became very modest, would remove his pajama trousers only under a sheet, and would not allow others to clean him after his defecations. He failed to be annoyed when other patients insulted him. He was lazy and had to be urged to do any sort of work. He played with his penis more than formerly, and went through the motions of coitus with his pillow.

By July 29, he had become more untidy, talked more about sex, and was asking women employees to go out with him. He continued to be lazy, generally slowed up in all his actions. Gradually he became more obstinate, exposed himself to employees and visitors alike, and used vile language toward doctors and nurses. He became actively homosexual unless watched carefully.

On August 19, 1942, he was transferred to a disturbed ward because of his combativeness and exhibitionism.

Since that time the monthly reports have characterized him as showing flights of ideas, poor judgment, lack of initiative, slowness of action, emotional blunting, laziness, playfulness, increased appetite, profanity, and sarcasm.

At a conference April 29, 1943, his condition was considered unchanged.

Having been examined three times previously, this patient was not re-tested prior to the operation, but because of the previous diagnosis of mental deficiency, the psychologist did not recommend lobotomy.

In the postoperational examination special interest was attached to the Maze performance. This was given on June 19, 1942, just three weeks after the lobotomy. He succeeded in the five- and six-year tests, but failed in year seven in two trials. He passed the nine-year test on the second trial, the 10-year on the first trial, but failed in the allotted two trials at 11 and the four trials in the 12-year design. This performance was rated at $8\frac{1}{2}$ years, IQ 61. Thus there was a loss of $4\frac{1}{2}$ years since the last examination given prior to the operation. Once again the familiar deficit in planning capacity was demonstrated.

On June 10, 1943, just about a year later, *B. K.*— was again examined. On this occasion his Maze test improved only to the extent of half a year. He succeeded in all tests up to 9 years on first trials, but failed in the 10- and 11-year designs. He also exhibited a common practice in these patients to run into the same blind alleys. This failure to learn from recent experience may reflect a tendency to stereotyped behavior. Once having

made a choice of reactions, it seems difficult for them to change. Versatility of response would seem to be the product of a brain in which the mechanism for organization is intact.

The Binet performance was also inferior. There was no loss of ability as regards arithmetical computations at nine- and eleven-year levels, but some impairment of rote memory ability. The present Binet level is $8\frac{1}{2}$ years, a loss of about 16 months in mental age. Whatever the results of the operation as regards the patient's psychosis may be, his mental deficiency has been increased.

H. CASE No. 8

This patient, C—K—, is a part-Hawaiian man, 24 years of age at the time of his commitment in January, 1939. He was diagnosed then as dementia praecox, simple type; some time later, however, the diagnosis was changed to dementia praecox, paranoid type. He was then delusional and had been hiding from imaginary gangs who were trying to kill him. In his efforts to escape from them, he wandered about the neighborhood at night and was a source of considerable disturbance.

The social worker, who investigated the case, reported that the patient, even in early childhood, had been solitary, seclusive, and very irritable. He could not hold a job and his unemployment was the subject of continual complaint and nagging by his family. He became alcoholic, possibly as a means of escape from family irritation. The patient's mother was reported to have been psychotic at intervals, and another relative was at one time an inmate of this hospital.

The physical examination, including Wasserman tests, both blood and spinal fluid, was negative. The patient seemed somewhat dull and retarded but denied that he thought people were persecuting him, and claimed and there was nothing wrong with him either physically or mentally. He said that his uncle had fabricated evidence that he was a mental case because he had got mad and torn up some things at home. He refused to work in the ward, and though generally quiet, was at times restless and very depressed.

A couple of weeks after commitment the patient showed definite paranoid trends and became so belligerent that he had to be transferred to a closed ward. At a conference called to consider the advisability of metrazol treatments, he refused to answer questions except by nods of the head. His metrazol treatment was stopped after one injection because of his belligerence

and resistance. By January, 1940, his condition had improved so much that he was allowed out on parole in the care of a relative.

At that time he was quiet and coöperative, well nourished, with no ideas of reference, hallucinations, or delusions. After three months on parole, he again became troublesome; he resisted advice and suggestions and refused to report to the Parole Clinic. Schizophrenic and paranoid reactions again became features of his behavior. The family were afraid of him and asked to have him put under restraint. With the aid of six policemen, he was persuaded to return to the hospital. For a few days he was depressed and moody and then became confused and violent, used obscene language, talked to himself, and was so belligerent that he was transferred to a closed ward.

An encephalogram was done on May 1, 1943, and this was reported by Dr. Ralph Cloward as being generally normal in appearance except for slight cortical atrophy of the right parietal lobe. He was then given six electric shock treatments but without noticeable improvement. Following these, a pre-lobotomy staff conference decided in favor of the operation. The psychologist concurred with this decision with the expectation that the patient's deep anxiety states would be relieved and his maniacal outbursts obviated.

Prior to psychosurgery the patient was restless, pacing backwards and forwards in the ward, and worrying about the effects of the treatment he was about to undergo. He said that he had been sent to the Hospital for destroying property but that he was no longer destructive. He could not remember how many years he had been at Kaneohe and when questioned, said that he preferred not to think about it. He was lazy and preoccupied and would help with the ward work only when asked to do so. At times he was moody; at others he talked freely, chiefly about his plans when released from the Hospital. Prefrontal lobotomy was performed on July 8, 1943.

Following the operation the patient did not show the typical reactions of mental confusion and excretory incontinence. He said he felt very well and wanted to get out of bed. His only complaint was of slight dizziness. He was reported as being very lazy and he preferred to talk to the attendants rather than work. His behavior showed a certain amount of tactlessness, taking such opportunities as presented themselves to smack the nurses on their posteriors and to carry out other unseemly acts. He gradually became more aggressive, took uncalled for liberties, and was very dictatorial, ordering the other patients around. He talked to himself, used obscene language

and became so irritable and surly that he was transferred to a closed ward. Almost immediately he became quiet and well behaved.

The Hospital notes for the month following the operation indicated some retardation and dulling, tactlessness, and ideas of reference. At other times he was apathetic, lazy, occasionally restless and profane. During the following month there was no marked change in his behavior. However, in the month of September his appetite improved, there was some gain in weight, and a general improvement in behavior. He seemed more sensible and less belligerent. He still showed some peculiar mannerisms, but was definitely better. He is now working in the Occupational Therapy Department, and when seen in October, seemed much more normal in general reactions.

Psychological Report

In the pre-lobotomy examination the examiner noted that if the test was brief and well defined, calling for a limited amount of sustained effort, the response was good. For example, he was able to repeat seven digits in order and his vocabulary was at a 14-year level. Despite this good rote memory, he failed in the reading and report test, which requires a much longer span of attentive effort. He could not reproduce the designs from memory nor the bead-chain series. However, he showed considerable ingenuity in piecing together a dissected sentence, but the association test, again requiring more sustained effort, was quite beyond his capacity; he could give only 10 words in three minutes with very marked mental blocking. His Binet test score was 11 years 6 months, *IQ* 82.

Responses in the Maze test were very interesting and significant. He went through the whole series with only one second trial in each of the 12- and 14-year designs. His final score was 14 years, *IQ* 100. His performance was characteristic of a person with perfectionist trends and undue anxiety. He was too much concerned with the careful tracing of the design and was thus slow and time-wasting as regards details of execution. His qualitative error score was, therefore, exceptionally good, being only 5 points. This would place him on the 92 percentile in this regard.

Interesting results were expected from prefrontal lobotomy, especially in the direction of quieting the patient's occasional violence and reducing his extreme anxiety states. The psychologist stated that it would be interesting to note whether the perfectionist attitude would be improved, though he thought the prospects in this respect were none too favorable. However, he definitely recommended the operation.

The post-lobotomy Binet examination was given on October 21, three and a half months after the operation, and revealed a relatively marked clarification of the patient's mental processes. He was now able to reproduce one of the bead-chain designs previously failed, his vocabulary score improved from a 12-year to an average adult level, and his definitions of abstract words were clearer and more satisfactory. From a previous mental level of 11 years 6 months, he rose to 12 years 2 months, equivalent to an increase of 5 points in Binet intelligence quotient. On the Maze test, however, he exhibited some commonly recognized post-operational reactions. He required two trials at the 8-year level, failed in the 9- and 11-year tests, succeeded in the 12-year test on the second trial, but required four attempts to pass the same test when inverted. He succeeded in the 14-year test on the second trial, and his final score was $9\frac{1}{2}$ years, *IQ* 68. Thus there was a loss of $3\frac{1}{2}$ years in test age and approximately 32 points in test quotient level.

The examiner noted that the patient was very slow and deliberate and studied each maze for a long time before attempting it. A very significant feature of the response was the almost complete disappearance of the perfectionist performance, indicating a lifting of anxiety. Formerly, every line was drawn slowly and as straight as possible and each corner turned at right angles. The patient now was not concerned with these details of execution but more with attaining the ultimate goal. The qualitative score was, under these circumstances, changed from 5 to 33 points, a decline from the 92 to the 27 percentile. Though his last performance is still within the normal range of variation, it represents a distinct change in mental attitude, and as far as this patient is concerned, the change is for the better. There were two repeated errors, a very characteristic reaction among lobotomy cases.

Though normally the test would not be repeated, the Maze was reapplied a short time afterwards. There was marked improvement, some of which should be attributed to practice effects. He required two trials on year 10 and failed year 14, with a repetition of one rather obvious error. The test age was now 11 years, still 3 years below his pre-operative level. The perfectionist attitude showed no signs of reestablishment. As a matter of fact, neither of the post-lobotomy performances, if compared with the original Maze, would be recognized as having been done by the same individual.

As regards general social adjustment, a marked improvement seems now

underway. He looks more normal, has got rid of a peculiar jerkiness in facial and body movements and seems generally brighter and more alert.

Summary

Diagnosed as schizophrenic, paranoid type, with delusions of persecution, this patient was violent and aggressive at times. No evidence of deterioration. A high Maze score and perfectionist response suggested deep anxiety. Recommended by the psychologist for operation. Mental condition clarified, disappearance of perfectionist attitude and anxiety. Maze response showed typical marked deficits with some later improvement, but continued tendency to repeat errors. After initial lack of improvement, social adjustment is now much better. Prognosis seems satisfactory.

I. CASE No. 9

This patient, T—I—, a Japanese male born in 1904, was first admitted to the Territorial Hospital in October, 1932, as a manic depressive, manic type. With the exception of a parole period of six months, during which time he visited Japan, he has been in this Hospital even since. Like many other Japanese, his parents believed either that a visit to their homeland would have magical therapeutic effects or else that they could there obtain medical or other advice more suited to the patient's needs. Unfortunately for this Territory, neither expectation was well founded, and the patient returned to be a charge on the community.

As a Japanese born among Hawaiians, he adopted superstitious ideas from both cultures. *Kahunas*, the local variety of evil spirits, had taken possession of him, their malign influence having centered itself in his sputum. This necessitated constant and most untimely expectoration on his part. The *kahunas* also manifested themselves as voices which he tried to dispel by throwing milk bottles in their direction. When the bottle shortage finally became acute, he was sent to the Hospital. At that time the physical examination was negative, including Wasserman, Kahn, stool, and blood tests.

During his first stay at the Hospital there was no improvement apparent. Two years after admission he was still incoherent at times with very little insight. His condition was said to be deteriorating. He was afraid that he was to be taken to some other hospital and cut up into small pieces. He became so disturbed that he had to be removed from the kitchen where he was working and placed in a closed ward.

After his return from Japan his condition was unchanged. He still heard

voices and believed that someone was hypnotizing him and that his family had turned against him, which was probably true. At the time of his re-admission he was hyperactive, apprehensive, delusional and hallucinating, though he seemed well oriented.

His mental condition became gradually worse so that the closed ward appeared to be his final disposition. He became filthy in habits and was sometimes covered with bruises as a result of his own or others' violence. He featured in many "special incidents" recorded at that time. In January, 1940, he was approved for metrazol treatment. At a staff conference on December 23, 1943, he was reported to be still hyperactive, aggressive, and violent at times. When asked his name, he answered: "*T— I—, former wrestler, jiu-jitsu, Japanese wrestler, balloon tire, white kind. I wish to chloroform me, disappear forever. Only God live forever.*" He was recommended for prefrontal lobotomy.

He was seen by the psychologist, who found him to be excited and euphoric, talking incessantly and devoid of insight. Though radical improvement could not be looked for, the psychologist felt that the operation might have a quieting, stabilizing effect, which would be helpful to institutional adjustment. Just before the operation he was reported to be confused, untidy, obscene, euphoric, with flight of ideas. He underwent psychosurgery on March 21, 1943.

After the operation he was more confused than before and passed through typical post-operational phases of incontinence, restlessness, mental confusion, etc. He picked at his bandages and went about kissing walls and benches, drawing pictures, saying good morning to everybody regardless of the time of day.

At first he was very lazy and distractible. He would sweep for a short time then play with the broom and rubbish. He was also addicted to playing with the water in the bathroom, though it was difficult to induce him to take a shower. Once in the bathroom, however, equal difficulty was experienced in getting him out. Such childish reactions are reported by Freeman and Watts as part of the initial reactions observed in many of their cases.

A month after operation he still exhibited lack of initiative, laziness, childish reactions, and increased appetite. In the four following months he was reported as being slow in action and thought, lazy, voluble and euphoric at times, delusional occasionally. His appetite continued to increase and his weight went from 91 pounds to 120 pounds. From this time on the patient showed steady improvement. He worked satisfactorily in the hospital

kitchen as a dishwasher, and was quieter, talking much more coherently and rationally. In consideration of this improvement, he was first placed on an open ward and then allowed the privilege of week-end paroles. If there is any residue of hallucinatory or delusional ideas, he does not seem to be disturbed thereby. On November 7th, seven and a half months after the operation, he was paroled from the Hospital and is employed as a dishwasher in a restaurant.

Psychological Report

This patient had entered the freshman grade in high school and attended two terms before being dropped on account of poor scholarship. At the time of the prelobotomy examination, he was 41 years of age. The psychologist did not find him very accessible to testing. He obtained a Binet score of 9 years 9 months, *IQ* 70. Successes above his mental age were mainly in language tests and one arithmetic test. He defined abstract words at a 13-year level, but could not repeat five digits backwards nor reproduce correctly designs from memory. Failures were noted in the interpretation of absurd pictures, nor could he repeat six digits in order. The word association test at 10 years was perhaps his most significant failure. He could give only 11 words in three minutes, and in spite of encouragement and checking, he could not be prevented from forgetting about the test and making incoherent remarks about other things. His attention could only be captured at intervals, and in between he kept up a continuous inconsequential chatter. There was no evidence of insight, and in common with psychotic cases of this type, he did his best work in short, well defined tests, such as word definitions or money computations. He failed any test that required sustained effort.

In the Maze test he could not go very far. The 5- and 6-year tests were accomplished successfully but he could go no further. The test age was therefore 6 years, *IQ* 43. As previously noted, the psychologist recommended operation in the hope that it would help his institutional adjustment rather than to bring about any radical improvement. The postlobotomy examination followed six months after the operation. Some of the expected benefits materialized, the patient being very quiet and cooperative with the previous volubility and flight of ideas no longer in evidence. However, it was still difficult to hold his attention. His vocabulary range was unchanged but he did not do so well in simple computation.

The Binet indicated a slight rise in mental status from 9 years 9 months to 10 years 1 month.

In the Maze test he failed at the 5-year level, but succeeded in the 6- and 7-year tests, and was unable to go any higher in the series. This gives him a test age of 6 years, the same as before, with, however, two repeated errors occurring at 5 and 8 years. This tendency was not apparent in his pre-lobotomy maze. It certainly indicates a lack of ability to profit by experience. This case illustrates the fact that prefrontal lobotomy does not ordinarily injure and may improve intellectual status, but that planning capacity and foresight, if inferior before the operation, will not be improved thereby. In the post-lobotomy maze, mechanical execution of the test was considerably better.

Summary

A manic depressive case of long standing with marked delusional and hallucinatory behavior. There was mental confusion and some evidence of intellectual deterioration. The mental age level was low, with least impairment apparent in language tests. Maze performance prior to operation was very inferior. Prefrontal lobotomy was recommended by the psychologist in the hope of improved social adjustment. Post-operational examination showed slight improvement in Binet but no change of score in the Maze. The patient showed a marked tendency to repeat errors. General adjustment in the Hospital was at first inferior but has recently improved to such a degree as to admit of his parole to a simple industrial occupation.

J. CASE NO. 10

This man, B— C—, is a Filipino, 32 years of age, who had been in the Territory 14 years. In July, 1942, he entered a general hospital in Honolulu complaining of a heart condition. At that time he spoke with a great effort and seemed listless and drowsy. Two years previously he had been seen by a psychiatrist who declared him to be psychoneurotic. In August, 1942, he was transferred to the care of the Bureau of Mental Hygiene at Queen's Hospital. At that time he was suffering from a self-inflicted wound near the right nipple, the weapon being an ice pick. He was later found attempting to hang himself by means of a towel tied around his neck. While hospitalized at the Bureau of Mental Hygiene, he was preoccupied, seclusive, and uncommunicative. An electrocardiograph reading showed an apparently normal heart condition. Most of the time he sat listlessly, his eyes staring with a

blank expression. Speech and movement were very slow, but he did respond briefly to questions. He still complained of pain in the cardiac region, and after the second suicidal attempt, he was committed to the Kaneohe Hospital.

When observed soon after admission, he was quiet, somewhat depressed, orderly, coöperative, and responsive. The physical examination revealed nothing of importance, blood and spinal fluid examinations gave normal results. X-ray examination of the chest was negative, showing no evidence of any special cardiac condition nor any indication of rib fracture or other condition that would account for his chest pain. He had been noticed continually punching himself in the side in his efforts to get rid of this pain. The examining physician found him to be mentally alert, with rational and coherent speech, no hallucinations nor delusions, well oriented, with good judgment and insight. He felt the patient was a manic depressive, depressive type, or possibly psychoneurotic.

Subsequent observations for a time showed nothing abnormal except that at times he was depressed and sat staring into space. He claimed that there was nothing wrong with him but at times his memory seemed affected, as on several occasions he had to be shown how to make his bed. He complained of anal irritation, but stools showed no ova nor parasites. At a diagnostic conference held on September 9, 1942, it was felt that the patient's behavior was markedly psychoneurotic, but the emotional depressions also pointed towards the diagnosis of manic depressive, depressive type.

Electric shock treatments were instituted in February, 1943, but after eight treatments extending over two and a half weeks, he appeared very confused and retarded in action and speech, hallucinatory and delusional. After examination, the psychologist's recommendation was favorable to prefrontal lobotomy on the grounds that it might be instrumental in lifting his depression and relieving his psychoneurotic traits.

An encephalogram was done on June 18, 1943. According to Dr. Cloward's interpretation, this showed moderate generalized cortical atrophy, more marked in the region of the Sylvian fissure and the Island of Reil, particularly in the left hemisphere. Dr. Cloward believed that this condition would not contraindicate prefrontal lobotomy. Following the pre-lobotomy conference, a tremor of the patient's right hand, which had previously been attributed to his psychoneurotic condition, was investigated further. Dr. Cloward confirmed the opinion of the staff that the patient's general appearance and physical findings were suggestive of a Parkinsonian syndrome of

undetermined origin. Lobotomy was therefore postponed to allow of a further interval of observation. Finally, on July 21, 1943, the operation was performed. Immediately prior to psychosurgery, the patient was reported to be untidy in habits, slow in movements, and quiet, but responsive and coöperative. A noteworthy feature in this case was that he was extremely eager to have the operation performed. Its effects had been described to him by another Filipino patient who assisted in the surgery. The patient said he wanted to get well.

Post-lobotomy X-ray showed a very even distribution of lipiodol over both frontal lobes, outlining a very extensive subcortical incision. The superior cut was unusually close to the vertex of the skull and the surface of the cerebral hemisphere. In the light of this circumstance, special importance attaches to the unusually marked post-operational mental deficits, reported later. In the lateral view the site of the incision lay approximately 1 cm. anterior to the coronal suture.

The first few days following the operation the patient was quiet and orderly, and lay with closed eyes, answering any questions in a slow weak voice. While in bed there was both rectal and bladder incontinence and he had to be kept in a soft camisole to prevent him from removing his bandages. When allowed out of bed, he walked very slowly, with his eyes half closed. Within a week of the operation he was apathetic, sat in one position, staring at the wall as if in a trance, and continually attempted to take off his bandages. A few days later he began to masturbate openly and excessively. He showed a childish retrogression towards unclean habits and continually wanted to play with water. When given dry clothes, he put them on over his wet ones. He was devoid of any semblance of modesty, tore his pajamas and trousers, and masturbated openly. The incontinence continued with obscenities, such as urinating in the drinking fountain, etc. There was also apparent at this time an uncontrollable shaking of the right arm and leg, manifestations of the Parkinsonian syndrome.

Behavior score sheets for July showed little or no improvement, while those for August recorded retardation of association, dullness of thought, slowness of action, lack of initiative, laziness, with occasional catatonic symptoms and negativism. Auto-erotic activities continued, and appetite increased. In September the notes recorded tactlessness, retardation, apathy, laziness, and increased appetite. However, incontinence and personal habits improved. In the following month rather marked changes in behavior were observed. The patient was given rabellon for the tremors which appeared

to be of extra-pyramidal origin. The patient gradually became quiet, orderly, cheerful and coöperative, and more rational in speech. He began to play checkers with the other patients, his moves being slow but well planned. He was also observed playing dominoes. His attention had to be prodded when it came to his turn to play, but his choice of dominoes seemed quite appropriate, and he was able to keep in mind the necessary arithmetical additions in making the play. At the present time he is showing some interest in ward activities, is neat and orderly, and generally much improved. The tremors have abated under treatment, and it is probable that this may have contributed to his general improvement.

Psychological Report

According to the patient's statement, he was educated in the Philippines, where he reached the fifth grade. In view of this limited educational background, he showed surprisingly good mental capacity. His Binet score was 12 years 3 months, *IQ* 88. He would undoubtedly have scored higher except for his poor facility in English. He reproduced correctly the bead-chain series, the changing clock hands test, and interpreted correctly the absurd picture at year 14. On the other hand, he could not repeat six digits in order and could give only 42 words in three minutes with many repetitions.

The Maze test was done very carefully and deliberately; his final score of 13½ years, *IQ* 96 was quite high. The usual penalties were allotted for a second trial in the 10-year design and for three trials at year 14. All other tests were passed on the first attempt. His reactions, however, were very slow and he showed a tendency to become over-absorbed in efforts to reach the goal, and in so doing forgot or disregarded instructions not to lift the pencil while drawing through the design.

Operation was recommended on the grounds that there was no evidence of mental impairment and that his Maze score was sufficiently high so that he could suffer an expected loss in planning capacity following the operation without becoming industrially useless. It was also anticipated that the emotional states of anxiety and depression would be relieved by psychosurgery.

The post-operative mental examination was given on October 7, 1942, about 11 weeks after the prefrontal lobotomy. Considerable improvement in social adjustment had by then begun to appear after a period of marked initial retrogression. Responses to the Binet test showed evidence of considerable intellectual deficit following surgery. The mental age had dropped from 12 years 3 months to 9 years 6 months, the *IQ* from 88 to 69. There

may be improvement later, as in other cases, but these early deficits are worth reporting to indicate what mental abilities suffer first.

As in Case No. 1, there was loss in the ability to repeat digits backwards, showing a lack of mental flexibility. This could be expected pending a reorganization of intracortical connections. Where formerly the patient was able to reproduce 12 items after reading a news paragraph through once, he was now able to give only five items in the same test. Another problem requiring some mental re-arrangement of material, the dissected sentence test, was also failed. He could not do the changing clock hands test, which also requires mental flexibility. On the other hand, the ability to define abstract words was unimpaired, despite the fact that the patient learned English subsequent to his arrival in Hawaii. Thus it is not priority of learning that determines order of loss; probably frequency of exercise of the function is of more importance in retention. In computing change, another operation frequently exercised, there was no loss in ability. In the previous test of word association, 31 words were given in two minutes, whereas on the post-operative examination he could only give 16 in the same time. There is evident a decided slowing down of mental processes.

In the Maze test the impairment was even more marked. The test score decreased from $13\frac{1}{2}$ to $8\frac{1}{2}$ years, equivalent to a drop of 35 points in *IQ*. On this second examination he required two trials in the 7-year design and failed all tests above the 9-year level. In the 10-year test he repeated the same error. Comparison with other patients' post-operative performances shows that this repetition of errors is common; apparently one of the early effects of the operation is to favor stereotyped reactions and to diminish the ability to profit by experience.

Summary

A manic depressive case, depressive type, in an old psychoneurotic with a Parkinsonian syndrome. Average mental capacity and good Maze performance prior to operation, which was recommended to relieve depressive state. Early post-operative reactions included mental confusion, bladder and rectal incontinence, masturbation, persistent childish behavior, with marked psychomotor retardation, followed by improvement beginning about three months after operation. Early post-operative examination showed marked loss in mental capacity, particularly in tests requiring mental flexibility. Ability in the Maze test suffered still more impairment, with tendency to repeat errors.

These deficits are probably related to the unusual intrusion of the surgical incision on the prefrontal cortex.

K. CASE No. 11

This patient, *K—M—*, a Japanese male born in 1902, was committed to the Hospital on the 7th of January, 1939. According to the examining physician, he had been troublesome and had made several suicidal attempts. The physical examination was negative. He had been a coffee farmer in Hawaii and had been married for seven years, and according to the wife's statement, had been drinking excessively since that time. He had had auditory hallucinations, suffered from insomnia, and had threatened violence. At a diagnostic conference, held January 31, 1939, his condition was believed to be due to alcoholic psychosis, with deterioration. At a staff conference held on June 30, 1939, his conduct was reported to be irritable and threatening, with a record of an assault on another patient. It was also brought out that he had been arrested for assault and battery, due probably to his alcoholism. He resented very much being confined to the Hospital. There was no insight into his own condition. From that time on there were constant reports about his combativeness and he became increasingly hostile to the doctors, who, he believed, were confining him unjustly. It became almost impossible to approach him without occasioning a manic outburst of aggressive and threatening behavior.

An encephalogram was done in 1942, and Dr. Cloward's report stated that the ventricles were normal in size and shape. There appeared to be, however, an extensive dilatation of the subarachnoid space. The diagnosis was subarachnoid cyst in the left cerebral hemisphere beneath the coronal suture near the vertex. There was also unusual aeration at the base of the skull. At a pre-lobotomy conference on March 11, 1943, this patient's diagnosis was changed to alcoholic psychosis, paranoid type, and he was recommended for lobotomy. The psychologist examined him on April 6, 1943, and the recommendation for lobotomy was favorable, as the mental examination showed that no mental deterioration had taken place. It was thought that the operation would have a quieting effect on his behavior. The operation was performed on the 10th of June, 1943. In this case typical reactions were observed following the operation. He picked at the bed clothes and tried to take off his bandages so that he had to be put into a soft camisole. There was urinary and rectal incontinence in bed. Six days after the operation sutures were removed and he was allowed out of bed. His appetite was

good. It was noticed then that he would do a little work and then lie down and rest, only to resume work a little later. At times he was lazy. Observations for the month of June indicated retardation of associations, slowness of thought, tactlessness, nervous tension, apathy, depression, lack of initiative, and laziness. Increased startle reaction was also noted. The ward reports for August recorded perseveration, meticulous reactions, euphoria, and increased appetite. He was, however, much improved both as regards general attitude and habits. He helped with the ward work and was continually busy. All the hostility previously displayed toward the doctors and the Hospital had disappeared. He was quiet, orderly, and pleasant in manner. The conclusion was that he was distinctly improved.

However, shortly after this time, a swelling in his neck was diagnosed as due to an inoperable metastatic carcinoma of the tongue; death followed on the 27th of September. For some time previously he had appeared somewhat confused but gave no trouble. A final statement by Dr. Ozawa states that previous to the operation this patient was considered one of the worst-behaved ever to be admitted. After prefrontal operation on the 10th of June, 1943, the immediate reaction was that of stupor and mental confusion. This rapidly cleared and he became docile, friendly, coöperative, responsive, and one of the best and most willing ward workers ever received in the ward. He did not complain and was a tireless worker. Two months after psychosurgery, examination showed ulceration at the side of the tongue and neck. In spite of the painful nature of the disease, the patient kept on working until in an interview a social worker asked him to give his permission for an autopsy in the event of his death. He became very angry and said, "I don't give a damn what the hell you do with my body." He then refused to do any more work, and went to bed and remained there until his death on September 27, 1943. Dr. Ozawa gave his opinion that the psychosurgery had brought about marked improvement.

Psychological Report

This patient, in spite of his most unfavorable hospital record, responded surprisingly well to the tests given pre-operatively. After an initial display of suspicion, he became very interested in the tasks set him and gained considerable satisfaction from his successes. Incidentally, this case, as well as several others, points an excellent lesson in occupational therapy. For some psychotic patients who have good to moderate ability but little educational opportunity, the therapeutic occupation that gives them most satisfaction is

mental rather than manual. For people who have worked with their hands all their lives, a purely mental task represents a marked and welcome change of activity and thus occasions real interest and affords relaxation. From a suspicious, sullen, and resistive attitude, the patient changed to coöperation and alertness during the testing.

In spite of having reached only the fifth grade in school, this patient made a score of 11 years 9 months in the Binet, with a resultant *IQ* of 84. He could not read and therefore failed the memory test with the news paragraph at the 10-year level. As was to be expected from his limited ability in English, he failed in vocabulary tests and also in the definition of abstract words. For most of his life he had spoken Japanese. On the other hand, he did the arithmetic problems at the average adult level, and was one of the very few subjects who noticed that the test of changing the clock hands (a 14-year test) poses impossible conditions. The subject is supposed to imagine that he can see the clock hands when the time is ten past eight o'clock and transpose them and tell what time it is then. The patient remarked that the hands in these positions cannot be transposed unless the clock is broken. There is no time of the day in which the hands are in the transposed situation. His statement that it is quite impossible to put the little hand where the big one is and the big one where the little one is when the time is ten past eight is, of course, quite correct. The lowest test failure was his inability to repeat four digits backwards at the 9-year level.

In the Maze test he showed corresponding alertness; he required two trials at the 9- and 14-year levels and his final score was 14 years, *IQ* 100. The qualitative score was 34, which is somewhat worse than average. However, this relatively inferior execution was partly due to a hand tremor that became more apparent as the test progressed.

Because the mental examination showed no intellectual deterioration, in spite of the more general deterioration noted in the original psychiatric diagnosis, it was held that lobotomy would be advisable. The psychologist thought that the marked irritability and combative behavior would be improved.

If it were true that fixed systems of reaction were disrupted by the operation, then marked improvement could be looked for, through the severance of subcortical association fibers.

After operation, the Binet examination revealed a loss of mental ability represented by a drop of eight months in test age, equivalent to four points in *IQ* level. The most marked deficit was in the word association test;

where previously he had given 78 words (35, 22, and 23 in successive minutes), he could now give only 5 in the first minute, 6 in the second, and 5 in the third, or a total of 16. His reactions were very slow, with particularly long pauses between one group of words and the next. He seemed oblivious of these pauses and then would continue. These "blocks" in verbal association are common among certain types of psychotic patients, usually schizophrenics.

Another post-operational deficit concerned the patient's arithmetical ability. He could pass only one of the three examples at the average adult level, in which he was previously correct. Again the error in the clock hands test was detected, the patient remarking that if the clock hands stood at 22 minutes 30 seconds past six o'clock, the hands could then be transposed. This observation indicated that eidetic imagery was not impaired.

A change in mental ability quite unusual with our series of prefrontal lobotomy patients was in the direction of gain as regards repeating digits backwards, a test commonly taken to indicate mental flexibility. The patient could formerly give only three digits backwards, and after the operation, increased his memory span to five digits reversed. This gain, however, was somewhat offset by a loss in forward memory span. Except for the unusual gain referred to above, the decrease in Binet score, together with the marked behavior symptoms immediately following the operation (incontinence, tactlessness, apathy, laziness, etc.), suggests that the incision was very complete, probably approaching the cortex closely.

The post-operative Maze performance was very interesting. The patient passed all tests on the first trial up to and including the design for year 10, and showed deliberation and good planning. In the 11-year design he repeated the same error twice. He succeeded in the 12-year test but repeated the same error three times. When it was inverted (following failure in the previous test), he again made the same error three times in succession and then passed the fourth trial. He then failed in the 14-year design again, making an identical error twice. Such a succession of repeated errors is most uncommon and could not be matched in many hundreds of normal cases.

His final score in this post-operative testing was $10\frac{1}{2}$ years, IQ 75. This represents a loss of $3\frac{1}{2}$ years and a drop of 25 points in test quotient. Here was an instance of the fact that loss of planning capacity and the ability to profit by experience is one of the commonest features of post-lobotomy changes.

Summary

An alcoholic psychotic with paranoid trends, a particularly troublesome and violent case, with no intellectual deterioration. Operation recommended by psychologist. Marked improvement as regards social reactions after initial retrogression. He became stabilized and capable of simple tasks. Mentally there were some deficits but a gain in flexibility. Marked deficit in planning and power to profit by experience as shown by Maze performance.

L. CASE No. 12

This patient, K— S—, a German woman born in 1907, was admitted on the 6th of April, 1940. At the time of admission she was depressed and retarded, answering questions in a low tone of voice but coherently and relevantly. She did not volunteer anything unless asked. She said she heard voices at night, but was correctly oriented. There was a history of considerable maladjustment while the patient was residing in Europe and South Africa, where she had received some of her education. In Honolulu she had been ill for some time and was treated at St. Francis Hospital, where she had been referred from the Sacred Heart Convent. She expected to enter the convent as a nun, but the Mother Superior was unwilling for her to take final vows. She had been employed in the music department, but she quarreled with the other nuns and could not handle the teaching. She then did housework, but she complained that the nuns were making a slave out of her. When displeased she would not eat. She was treated with metrazol and improved sufficiently to warrant plans being made by the Convent to send her as a housekeeper to Maui. However, she became more disturbed and it was decided to commit her to Kaneohe Hospital.

At the diagnostic conference, it was stated that she had been in the Bureau of Mental Hygiene for three weeks and there had metrazol treatments. In the interview she was very uncommunicative; she admitted hearing voices but would not report what they said. The diagnosis was manic depressive, depressive type. She was considered for discharge at a conference on January 17, 1941, and at that time the question of her return to the convent was discussed, but in view of her depressed and hallucinating condition, this was not held to be advisable.

At a pre-lobotomy conference held on the 11th of March, 1943, it was stated that she had received both electric shock and metrazol treatments for some time but without any permanent effects in the way of improvement. With this history it was determined to have an encephalogram taken and then

decide on the advisability of operation. The psychological recommendation was adverse to the operation provided that she was of the manic depressive type with periods of alternating depression and euphoria. Some of the recent reports had indicated that there were times when she seemed in good spirits. The encephalogram showed an essentially normal picture except that there were multiple small localized areas suggestive of cortical atrophy in both frontal lobes. At the pre-lobotomy conference, the large number of metrazol and electric shock treatments were referred to and the statement made that her condition would be much improved for a few weeks and then she would regress to her former condition. The diagnosis was reviewed at this conference inasmuch as some of her behavior was suggestive of dementia praecox, paranoid type, although the outstanding mood was one of depression, in which she sat and stared at the floor and refused to talk to anybody. The previous diagnosis of manic-depressive psychosis, depressive type, was confirmed, and operation was recommended.

Dr. Cloward stated that in the operation itself more hemorrhage than usual was encountered, especially on the left side; also spinal fluid came from the trephine hole on both sides after the knife was withdrawn, indicating probably that the lateral ventricle had been entered. The operation was performed on July 22, 1943. Immediately prior to surgery, she was in good spirits and pleasant in behavior, spending most of her time reading her prayer book. She was anxious to know what treatment she was to undergo, and on the morning of the operation was much depressed, saying that that was the day she was to die. Her condition immediately following psychosurgery was fairly good. She complained of headache. Her appetite was only fair. She would answer only when spoken to. Her facial expression was listless. She was, however, reported quiet and cooperative. Two days later she was extremely restless at times, and distinterested in her surroundings. A week after the operation, the most distinctive feature was her lack of initiative. She had to be coaxed to get out of bed, answered questions in a dull indifferent manner, and had to be constantly encouraged to do any work. She had to be reminded also to change her clothing. The July ward notes instanced confusion, delusions, emotional stupor and depression, lack of initiative, laziness. The following month she was reported to be somnolent, anxious, depressed, slow in action, lazy, lacking in initiative, negativistic, and unsteady in her movements, with increased appetite. In September the picture had not changed; she was still slow in her reactions, somnolent, irritable at times, depressed, lazy, procrastinating, and lacking

in initiative. She was also reported to be sarcastic at times, and her appetite was increasing. The general picture was one of lack of improvement.

Psychological Report

This patient was examined six weeks prior to the operation and obtained a Binet score of 10 years 10 months, *IQ* 77. In spite of the fact that she was clever at drawing, she was able to reproduce only one of the memory designs. Her attempt at the 11-year test was particularly poor. She defined only 12 of the words in the Terman and Merrill vocabulary test, but was able to define abstract words at a 13-year level. She could not, however, repeat four digits backwards nor detect the absurdity in a picture at a 10-year level. She had learned English after she was already familiar with French and German, but the fact that she could master languages in this way indicated considerable original intelligence. The fact that her highest credits were scored in language tests, as contrasted with her failure in memory tests at a lower level, could be taken as evidence of mental deterioration. It was noteworthy, however, that she did well in the word association test, giving 71 words in three minutes without many of the customary blockages in association common among schizophrenics.

The Maze test was performed with indifferent success. She required two trials on the 9-year design and passed no tests beyond that level. Her score, therefore, was $8\frac{1}{2}$ years, *IQ* 61, and this poor performance was considered indicative of a degree of mental deterioration. Lobotomy was therefore not recommended by the psychologist. There was some tendency for her to exhibit cycles of depression and periods of euphoria. It was felt that it was expecting too much to think that the operation could relieve opposite emotional reactions recurring in the same individual. Deficits in planning capacity and initiative frequently follow lobotomy and when these are already apparent, the expectation was that the patient might easily find everyday adaptations and adjustments even more difficult than before.

The post-lobotomy examination showed gain rather than loss in mental ability. Language facility remained unchanged and the patient was now able to repeat four digits in reverse order and succeeded in reproducing the 11-year memory design and the bead-chain series. Her mental age was 11 years 4 months, *IQ* 81, an improvement of 4 points. In the word association test her score dropped from 71 to 64 words given in three minutes.

The post-lobotomy Maze examination showed no improvement over her previous score. She had more difficulty in adjusting herself to the conditions

of the test and consequently failed in the 5-year test. She required two trials in the 8-year design and failed in the 11- and 12-year designs and earned a final score of $8\frac{1}{2}$ years, with the same *IQ* as before. Normally, practice effects are apparent in Maze test performance, especially when an interval of only a few months separates the two performances. Hence, a similar score signifies a loss in ability.

The examiner noted that the patient was coöperative and interested during the testing but became irrational and paranoid as soon as her personal situation was discussed. Unfortunately, the inferior Maze test performance is more indicative of her present ability to adjust herself than is her improved Binet score. As will be seen from the ward reports, there was less willingness to coöperate even though there was no apparent loss in industrial capacity.

Summary

A manic depressive case with some evidence of deterioration and inferior social adjustability as indicated by a low Maze score. The operation was not recommended. Post-operative condition unchanged or slightly worse. More insistent complaints and dissatisfaction with hospital treatment. The Maze test was originally very low and the patient showed no improvement in post-operative performance.

M. CASE No. 13

This man, K— K—, a Japanese born in Hawaii in 1906, was first admitted to the Hospital in March, 1936. He was uncoöperative, would answer hardly any questions, and obeyed instructions very slowly. He was continually wringing his hands and pouting his lips. He would talk to himself for a time and then take up an attitude of listening as if he heard voices. There was considerable depression and he said he believed his heart was decaying. The physical examination was negative except for an intestinal worm infestation, which was soon cleared up. A diagnosis of dementia praecox, catatonic type, was made.

Three months after admission there was no improvement. He was still seclusive, delusional, and hallucinatory. He showed no interest in his surroundings, lacked insight, and was at times very restless, being unable to remain in one position or at one activity for any length of time. On other occasions he would sit or stand by himself, gazing into space. A year later he still lacked insight and was occasionally resisting or belligerent.

During July and August, 1938, he was given a series of metrazol treat-

ments, but after his refusal to continue they were stopped. Three months later he was reported to be uncoöperative, quiet, and preoccupied. Metrazol treatments were again instituted for two months, during which time 15 doses were given. At a conference following this treatment, he was declared to be somewhat improved. He was more communicative, but was untidy and still confined to a closed ward.

In May, 1939, he had a fight with another patient, 'whom he attacked without apparent provocation. He was occasionally allowed week-end paroles and seemed to be improved. His progress, however, did not continue, as at a conference called to consider further parole, he was found to be still seclusive and uncommunicative, with no insight into his condition.

Repeated applications for parole were considered, but on each occasion his condition did not warrant granting these requests. In July, 1941, his chief occupation was said to be sitting on the floor all day. A year later he was much the same, would not talk unless directly addressed, and when answering questions he hid his face and spoke in monosyllables.

At a pre-lobotomy conference held on the 18th of November, 1942, it was thought that there was not a great deal of deterioration. Dr. Cloward's report on the patient's encephalogram stated that the ventricles were normal in size. A skull defect in the parietal region was apparent, but the general appearance was normal. At the conference, lobotomy was suggested, and in this the psychologist concurred on the grounds that deterioration in this patient was probably more apparent than real.

The behavior prior to the operation continued much the same as previously reported. He was quiet, uncommunicative, untidy in habits, refusing to talk to either attendants or other patients. When urged to do so, he would help in ward work. His appetite was reported to be fair, but in eating he was very careless, dropping his food from his plate. At that time there was a notation that he was masturbating openly, the first record of that kind to be made against him. The operation was performed on August 5, 1943.

Dr. Cloward's report on the post-lobotomy X-ray stated that there was very poor distribution of oil along the plane of the incision, which was apparently slightly anterior to the coronal suture and extending to within 1 cm. of the vertex of the brain. Apparently the lobotomy incision cut through the arachnoid membrane at the base of the brain so that the lipiodol escaped into the sub-arachnoid space on the under surface of the frontal lobe.

Immediately following the operation the patient was very quiet, slept most of the time, urinated in the bed, and when awake, constantly tried to

masturbate. This increase in sexuality became the outstanding feature of his post-operational behavior. The day following he was apathetic and listless and very slow in movement.

He would not respond when spoken to. A few days after psychosurgery he was grossly untidy in dress, was masturbating excessively, appeared absolutely devoid of modesty, and was extremely lazy. Ward reports for August stress tactlessness, poor judgment, apathy, slowness, lack of initiative, laziness, and sexual overactivity. In September, the reports mentioned that he was still lazy and lacking in initiative. He masturbated but not so openly. Most of the day he sat in the solarium, smiling and talking softly to himself. Appetite was noted as increasing but there was no marked addition to weight. The apathy, slowness, laziness, and masturbation continued to be the most marked features in his behavior.

Psychological Report

In this case there was evidently a faulty recommendation on the part of the psychologist as to the advisability of operation. This recommendation was based on the fact that at the time of the pre-lobotomy examination the mental level was comparatively high. Certain test responses indicated that there was more ability present than was apparent and that failure in other tests was due to inaccessibility rather than deteriorated intelligence. The psychologist's comment was "Although there is some mental retrogression, it is not so marked as to indicate a decisive loss in mental ability. In this case there is something to salvage."

Had sufficient account been taken of the fact that the patient was a university graduate and had been for three years doing excellent work as a member of the U. S. Geological Survey staff, it should have been obvious that the mental retrogression was really serious, and this should have constituted a contraindication for surgical measures.

This man had first been referred to the Psychological Clinic in 1934, his immediate superior having reported that his work was beginning to be very inaccurate and haphazard. He also reported that the patient had difficulty in completing jobs assigned to him. At the time of this examination he was very apathetic regarding this phase of his difficulties, but was very ready to talk about a disappointment in a love affair with a Japanese girl who had refused to marry him.

In the pre-lobotomy Binet examination the patient scored 12 years 9 months, his most significant failure being his inability to repeat five digits

backwards, indicating loss of mental flexibility. His vocabulary was at an average adult level, but the examiner found it very difficult to hold his interest, as he was coöperative and negativistic by turns. There were flashes of intelligent effort, and during one of these he was able to define fairly difficult words yet failed to give any response in regard to simpler definitions. This rather surprising feature of the behavior influenced the examiner in the assumption that the patient was not displaying his real capacity. Undoubtedly the decline in tests of mental flexibility as compared with vocabulary and the fact of his distractibility and general moral retrogression should have been given more weight as evidence of deterioration.

The Maze test called forth more sustained effort and interest on his part. He studied the tests before beginning them and was very careful at difficult "choice points." Nevertheless, he required two trials at the 7-year level, two at the 10, and four in the 14-year design, where he repeated the same error.

In the mental examination following the operation, the patient displayed the same emotional apathy as before. During the test he ceaselessly moved his lips as though whispering to himself, and answered questions in a very flat tone devoid of emotional expression. In the Binet he failed the 11-year memory for designs test, could not define abstract words as formerly, and would give no response at all in the vocabulary test. He was withdrawn and showed little animation in any way. His mental level was considerably lower than formerly, but whether this was due to loss of capacity or more marked inaccessibility could not be accurately determined.

However, the Maze test again seemed to attract his interest. On this test he required two trials at the 10-year level, and failed completely in the 14-year test, repeating the same error twice. He was allowed a fifth trial in this test and again was unsuccessful. The score was $11\frac{1}{2}$ years, a loss of one year in test age. There was considerable improvement in the quality of performance, his qualitative error score dropping from 35 to 13. Possibly this improvement indicated a more meticulous attitude towards a task.

Summary

Dementia praecox, catatonic type. Recommendations for operation was concurred in by the psychologist on account of lack of recognition of deteriorative symptoms. His pre-operative level of intelligence indicated considerable decline from his original mental status. Post-operative condition is unchanged, or possibly worse. Some retrogression in Maze test age was noted,

with improvement in quality of execution. The Binet level is lower but patient is less accessible to mental examination than formerly.

N. CASE No. 14

This patient, *T—H—*, a Japanese male born in 1921, was admitted to the Hospital on January 12, 1943, with a history, extending over five years, of maladjustment socially and in family relationships. He had a very peculiar personality, and would fly into very violent tempers in which he would strike his mother or sisters. If he was opposed in any way, he would wander away from home, and on several occasions he had been arrested for being out after black-out hours. There is no doubt that he has been psychopathic for a considerable time.

A communication from the Bureau of Mental Hygiene in Honolulu stated that he had been first brought to the Clinic on January 10, 1941. He complained of hearing voices all the time and was found to be mentally retarded and psychotic. The diagnosis was schizophrenia, paranoid type. He was given metrazol shock therapy and improved so much that he was shortly discharged. About a month later, however, he was brought back to the Bureau of Mental Hygiene by the family, who reported their inability to control him. He would give way to sudden rages and would sometimes upset the dining table at meals and strike members of the family. His relatives preferred to keep him at home rather than have him institutionalized.

On November 11, 1942, the patient returned voluntarily to the Bureau asking to be hospitalized. He complained of many physical ailments and heard voices continually. He was again discharged as improved and returned home.

On January 10, 1943, there was a particularly violent outbreak at home, and as the patient's two elder brothers had been inducted into the army, there was no one able to assist the father in his management and control. The family called the police and he was brought by them to the Bureau of Mental Hygiene. Two days later he was transferred to the Kaneohe Hospital.

The physical examination at that time was substantially negative and the impression formed by the examining physicians was that the patient was schizophrenic with paranoid trends. In the ward he was reported by attendants as being confused and depressed at times, at others smiling and talking to himself, without interest in his surroundings. He assisted with the work in the wards when asked to do so, and responded fairly well to

questions. He was quiet and orderly and said that he was so crazy that he was always getting into fights, but that he felt better. Hydrotherapy was begun but difficulty was experienced in persuading him to continue treatments.

At a diagnostic conference held on the 19th of January, 1943, he was diagnosed as dementia praecox, paranoid type, and it was determined to give him electric shock treatment, which was carried out during the next month. This was followed by a conference on the 7th of July, in which it was declared that there was no improvement. In view of the long history of psychotic behavior and his failure to respond to electric shock treatment, it was decided to consider him for lobotomy. The psychologist's report was unfavorable on account of the initial low mentality. Whether or not the paranoid trends would be improved was held to be problematical. The only favorable feature was his high Maze performance, indicating that he could still suffer some impairment of planning capacity following the operation without decisive loss.

The encephalogram showed considerable dilatation of the left lateral ventricle, which was approximately twice the size of the right ventricle. On lateral view this dilatation seemed generalized and symmetrical. This indicated probable degenerative change in the basal ganglia and deep subcortical white matter of the left cerebral hemisphere, either post-traumatic or post-infectious. In Dr. Cloward's opinion, while the encephalogram indicated organic change in the brain, this was not to be considered a contraindication to lobotomy. The operation was accordingly carried out on the 19th of August, 1943.

Immediately prior to the operation he helped a little with the ward work, responded only when spoken to, and was reported to be somewhat untidy. He seemed worried but was coöperative and moderately responsive. The symptoms immediately following the operation were hardly typical; there was only one record of bladder incontinence and restlessness on the day following the operation; thereafter he was quiet and bathed himself with a little coaxing. His appetite was good, his behavior was quiet and responsive, and there was nothing unusual in his behavior to record. Four days after the operation his stitches were removed. He stated that he felt a little dizzy, but was able to walk about normally. He was considerably troubled by vomiting. Examination at that time showed no abnormal findings except for a slight bulging of the operative incisions and a low-grade fever. The spinal fluid showed a few red blood cells, but no other abnormalities. The vomiting gradually ceased after this spinal puncture.

The attendant noted that he would respond if spoken to but did not initiate conversation. He was willing and able to attend to himself. He began to be interested in reading newspapers and magazines. On the 25th of August, he became angry when told to mop the ward, but finally did the work assigned. He was reported to be neat but slow in moving. He liked to lie on a bench and would sleep all day if allowed. When asked to do ward work, he would do so but with a sullen and unwilling attitude. His appetite was improving but he showed very little interest in his surroundings. Early in September improvement in his mental condition was noted, with a great increase in appetite. He seemed also to be in better spirits. He helped with the ward work when asked to do so, but was still lacking in initiative. The attendant noted that he was always going to the dining-room in expectation of getting something more to eat. The improvement in his mental attitude continued; he seemed happier, laughed heartily to himself occasionally, and looked at magazines and newspapers. There was still slowness of movement. By the middle of September he was more responsive and worked much better. His appetite continued good. At times he swept the porch voluntarily, but was very slow in movements and did not converse with other patients. For the month of September some tactlessness was recorded, with apathy and slowness of reaction and increased appetite the most marked features of his behavior. Dr. Ozawa's report on his post-lobotomy reactions confirmed the above observations. He noted that he did not wet his bed but that three days after surgery the patient had fever. When given ward work to do he was very slow but meticulous. The paranoid ideas still remained but he seemed to be less concerned about them. October observations include euphoria, meticulous reactions, retardation of action, and increased appetite. He is considered to be somewhat improved.

Psychological Report

This patient had been brought for examination to the Psychological Clinic of the University of Hawaii on January 30, 1941, while a patient of the Bureau of Mental Hygiene. This was two years prior to his admission to the Kanohe Hospital. At the time of this examination he was reported by the assistant psychologist at the Clinic to be of only borderline intelligence. This was on the basis of a low Binet *IQ* of 64. However, abnormal reactions were also noted, such as distortion of facts contained in a news paragraph and more particularly, blockages of response in the word association test. The patient could give only 28 words in three minutes.

In the Maze test he seemed mentally confused and made several errors at a simple level, while succeeding in higher tests. One of these failures occurred as low as a 5-year level. In a test of range of local information, he scored at a 13½-year level, with very slow reactions. At the time of examination he was 19 years of age.

The outstanding feature of this man's pre-lobotomy mental examination was his extreme verbal inarticulation. He had pronounced mental blockings so that it seemed quite painful for him to express the simplest ideas. In the word association test (10-year level) he could only give 21 words. He read the news paragraph very jerkily and could recollect only three items. The only success above a 10-year level was in the first bead-chain design. The comparatively low level of 9 years 3 months, *IQ* 66, was consistent with the fact that he reached only the seventh grade in school.

In the Maze test, however, he did not show the same slowness of reactions. His decisions were made with average speed and the examiner felt that his performance would have improved if he had taken more time for preconsideration. He required two trials in the 10-year test and three at the 14-year level. The resultant test score was 13½ years, *IQ* 97, but it should be noted that this was the second application of the test and practice effects could be expected.

Though there was little evidence of organic deterioration, lobotomy was not recommended on the grounds that the low mentality could not be improved and that the chances were about even that the paranoid trends would disappear.

As will be noted from the hospital records, this was one of the cases in which operation was not followed by a period of mental confusion, and, as in other similar situations, the post-operative mental testing gave practically identical results as the pre-operative. In other words, there were no marked mental effects of prefrontal lobotomy either in post-operative behavior or test responses. Yet improvement is recorded in simple social adjustments. Whether this improvement will last is yet to be proved. According to Freeman and Watts, the absence of the post-operative symptoms of mental confusion is an indication that the operation, from the surgical point of view, was not successful.⁵

⁵"There is a phase that patients pass through . . . characterized by more or less complete blankness and inertia, with no realization of the passage of time, with disorientation in space and often to person, with complete amnesia for the recent past" (Freeman and Watts, "Prefrontal lobotomy," *Amer. J. Psychiat.*, May, 1943). Elsewhere they refer to this disorientation as "a yardstick for satisfactory operation" ("Prefrontal lobotomy," *Bull. N. Y. Acad. Med.*, December, 1942).

The post-operative Binet results were identical with the first testing except that credit was obtained for an 11-year problem in money computation and for an opposite analogies test at year 8. Such improvements in score are, however, quite consistent with the normal variation in results when tests are reapplied within an interval of a few weeks. In this case, less than six weeks elapsed between the two testings. Again, only three items were recalled in the reading and report test, and the association test result was worse than before. The patient could give only eight words in three minutes, evidence of very significant mental blocking.

The Maze test (third application) was attacked with interest. The only second trial needed was at year 14, and apart from a rather marked disregard of instructions against lifting the pencil, the performance as normal as regards qualitative aspects. The final score was 14½ years, the improvement of one year over the previous testing being quite within the range of practice effects for a third application. In effect, four weeks after the operation the Maze performance was essentially unchanged.

Summary

A dementia praecox of pananoid type, with low mentality. Operation not recommended because inferior mental capacity would still make his adjustment difficult. Typical reactions absent from post-operative behavior. Test results unchanged except for practice effects. Improvement in social adjustment initially noted. Patient is not as lazy nor as uncoöperative as before.

O. CASE No. 15

This patient, *K—W—*, a Chinese male born in 1897, was admitted in January, 1932, and the physical condition at that time was essentially negative. The patient was reported to be euphoric, distractible, disoriented, confused, and resistive, with a tendency to wander. The ward notes after admission recorded that he talked all the time to himself and had a silly manner. He was diagnosed as a manic depressive, manic type. Most of the time since his admission he has been in a closed ward, as he lacked insight, was disoriented, and reacted to auditory hallucinations. At a pre-lobotomy conference on January 5, 1943, he was reported as doing no useful work, lying around all day without interest in his surroundings. If left alone, he stayed without initiative in one place all the time. There was thought to be considerable deterioration and it was recommended that if electric shock treatments were found to be ineffective, lobotomy should be

performed. Nine electric shock treatments were given in February and March of 1943, without improvement.

An encephalogram was done on the 19th of January, 1943, and this showed localized bilateral cortical atrophy in the posterior portion of the frontal lobes; otherwise, the picture was normal. The psychological examination showed no marked intellectual deterioration but considerable emotional retrogression. Though little in the way of community adjustment could be hoped for from the operation, there was a chance that it would be beneficial to some minor degree in institutional adjustment. Lobotomy was carried out on June 10, 1943, and his immediate reactions after surgery were mental confusion, laziness, occasional restlessness, and incontinence. Ward notes recorded retardation of association, dullness, mental confusion, disorientation, euphoria, and apathy alternating with depression. He was slow in action, lazy, and lacked initiative. There was increased appetite. In August, tactlessness, poor judgment, emotional stupor, slowness of action, laziness, and lack of initiative and increased appetite were outstanding. Later on he became silly, apparently a deteriorated type of individual and unresponsive. After a time he was able to do a little work, but he was still very lazy and stood around grinning most of the time. October's ward reports showed no change in the picture, so that he is considered definitely unimproved.

Psychological Report

The deteriorative trends, previously mentioned as indicated by the patient's general behavior, were also apparent in the pre-lobotomy Binet examination. His mental efforts were spasmodic and attention was not well sustained. Stereotyped reactions were present, such as continuous swinging of the head from side to side so as to rub his chin against the back of his hand placed on the edge of the table. Part of the time during the examination he sang softly and muttered to himself, and wore a foolish grin. He stated that he graduated from high school in 1917 and was subsequently employed in his father's restaurant and also for some years as a bookkeeper in another business.

The unevenness of response to Binet tests characteristic of mental retrogression was apparent in this case. He had the vocabulary range of the lowest division of superior adults and arithmetical ability at an average adult level. But he could not interpret the absurd picture at a 10-year level nor copy the bead-chain design series from memory. He could repeat only four digits in reversed order, an achievement much below the normal level. His

test age was 12 years, *IQ* 86. The patient's Maze performance was also inferior. His test age was 11½ years, with a test quotient of 82. He continued to sing throughout the testing and giggled foolishly when he made an error.

The psychologist's statement with regard to the advisability of lobotomy was of equivocal character, his opinion being that it "could not do any harm and may be beneficial." Emotional retrogression and childishness in behavior in the patient were emphasized in the report. The indications of deterioration were not considered as favorable auguries for any marked improvement.

The post-operative Binet brought to light some losses, particularly as regards memory for designs, ability to recollect items from a news paragraph (year 10), and an unusual deficit in range of vocabulary. This fell markedly from a superior adult level to less than a 12-year score. This is in sharp contrast to experience with most other patients. Another unusual loss was in arithmetical ability. The final mental age was 10½ years, *IQ* 75, a drop of 11 points.

It is cases like *K—W—* which give substance to the probability that slight differences in surgical technique, such as the close approach of the incision to the vertex, affect the degree of mental changes that follow. The unusual mental deficits, on the other hand, may be associated with the fact that some cortical atrophy of the portions of the frontal lobes unaffected by the operation was indicated by the encephalogram.

The postoperative Maze test performance accorded well with results obtained in other cases. There was some loss in planning capacity, second trials being required for success in the 5-, 7-, and 9-year designs, with complete failure in tests above 11 years. The test age was 9½ years, *IQ* 68. There were two repeated errors in the 12-year design and three repetitions of the same mistake at the 14-year level. As will be seen in a later tabulation, these repeated errors are more characteristic of our series of lobotomy patients than of any other group of individuals, such as normals, delinquents, and even feeble-minded.

Summary

This case, a manic depressive of long standing, with some frontal lobe atrophy, and a foolish deteriorated manner, showed the typical reactions after prefrontal lobotomy, but there was no improvement in attitude or behavior. Some mental deficits plus loss in Maze test score, with inability to profit by experience, provided added evidence that surgically the operation was ade-

quate. It is possible that these losses may be ascribed to lobotomy effects superimposed on an already partially disorganized brain.

P. CASE No. 16

This patient, S— T—, a Caucasian male born in 1908, was committed to the Hospital on the 29th of April, 1940. He had been in the army for three years as clerk in an air squadron but obtained a discharge in July, 1937. Since then he worked as a taxi driver and became very interested in a Korean girl, who earned her living as a taxi dancer. He was very delusional regarding the activities of a man named Rat Smith, who was in the army with him. He believed that this man, through political influence, was responsible for his commitment. Though he was without funds, he proposed to get married and move with his wife to Russia. At a diagnostic conference held on May 14, 1940, it was stated that he had written letters to Roosevelt, Mussolini, Hitler, Hoover, etc., regarding his commitment. The reports from the ward indicate that he was depressed, seclusive, and delusional. The physical examination was negative. He told a long story about his connection with Rat Smith and the money that he paid to him to arrange for his discharge from the army. He believed that this man's enmity had caused him to lose many jobs. Though Smith was only a cook in the army, he credited him with all kinds of diplomatic connections and with the ability to rob him of credit for suggestions he had made to Mussolini, Hitler, and Roosevelt. The diagnosis of schizophrenia, paranoid type, was made. In July, 1940, he escaped from the Hospital, but was apprehended and returned the same day. On the 9th of April, 1942, a staff conference was held in regard to this case. It was stated at that time that he wrote about three letters each week to various prominent people regarding his commitment. The patient maintained that it was a political frame-up and was due to the scheming of Rat Smith. He claimed that there was considerable sabotage going on in the institution. He was declared to be delusional, silly, and entirely lacking in insight. He again escaped from the institution on March 11, 1943, and was returned to the Hospital by the police two days later. At a staff conference held on the 14th of July, 1943, he was recommended for lobotomy. An encephalogram had been done by Dr. Cloward, who reported that there was possibly moderate generalized cortical atrophy, more marked on the left side. His intellect was considered to be well preserved, but it was held doubtful whether his paranoid condition would be improved by psychosurgery.

His behavior immediately prior to the operation was reported to be seclusive, but he would respond when spoken to and would work when asked to help. Most of his time was spent in reading and smoking. The lobotomy was performed on the 29th of July, 1943. The post-operative behavior on the day following the operation showed restlessness, but apparently no mental confusion nor disorientation. He asked if he should change his clothes and go back to the ward. He said that he felt fine and that he had no complaints. Apparently there was no incontinence. His appetite was good. Two days later he was coöperative and responsive and read a good deal. He was able to bathe himself but there was some psychomotor retardation noted. He took about 20 minutes to drink a cup of milk. A typical post-lobotomy feature was his restlessness and trying to get out of bed. Four days after the operation he was reported as being quiet but very slow in reactions; it took him a great while to bathe himself and he ate very slowly, but seemed somewhat improved in spirits. He showed some negativism. On the 6th of August he was reported as doing no ward work but continually washing his hands. He was neat and orderly, with good appetite. He did not associate with the other patients. He enjoyed reading and listening to the radio. The August ward report emphasized perseveration, meticulous behavior, lack of initiative, laziness, and increased appetite. His paranoid ideas still seemed to persist, but he was emotionally less concerned about them. In a staff conference, he stated that he believed Rat Smith had left the islands and that therefore there was no necessity for writing any further letters to authorities about him.

The reports for October noted euphoria and increased appetite as the only noticeable change. He is considered to be improved though the paranoid ideas still persist, though possibly they are less dominant in his general behavior.

Psychological Report

This patient stated that he graduated from Junior College and that his father was a university professor. Mentally he proved to be of superior intelligence, his only failures in the modified Binet examination being in one of the ingenuity tests, the enclosed boxes problem, the difference between abstract words such as poverty and misery, and the interpretation of proverbs. The Binet level was 20 years 2 months, *IQ* 134.

The Maze test performance was equally satisfactory, as he passed all the tests on the first trial, with the exception of the 12-year design, in which he

made one mistake. The adult test was not given, but his score up to that point was $1\frac{1}{2}$ years, *IQ* 104 plus. The psychologist noted that the patient was extremely careful and rather hesitant. He appeared to be over-anxious and sometimes deliberated a long time over rather simple choices.

The post-operative examination was given on October 21st, three months after psychosurgery. At that time there was no change at all in the Binet results except that the difference between abstract terms was correctly given, increasing his mental age rating by three months.

The Maze test performance was also similar, the test age being the same as before. The quality of execution was somewhat inferior to his pre-operative performance, his qualitative error score being 17 points as against a former score of 10 points.

Because of the almost completely unchanged mental picture after operation, the post-operational reactions of this patient were carefully checked. At first there was restlessness in bed, stubbornness, together with attempts to remove the bandages. There was one record of urinary incontinence the second day after the operation. There was no record of mental confusion and the only common post-operative symptoms were increased appetite and slow psychomotor reactions, such as lingering over meals and in the bath. He claimed that he felt exactly the same after the operation as before. In view of the absence of mental confusion and mental change, it would seem that the operative incision was possibly not extensive enough.

Summary

A schizophrenic with paranoid ideas, mainly concerned with plots to have him confined to a mental hospital. Mental examination showed high-level capacity with no mental deterioration. Lobotomy was recommended. Post-operative reactions showed little change. There was some psychomotor retardation but no disorientation after the operation, with quick return to former condition. Emotional attitude was slightly improved, but delusional ideas persist. Patient is now allowed in an open ward.

P. CASE No. 17

This patient, L— M—, a Filipino male born in 1915, was admitted to the Hospital on the 27th of February, 1943, having been transferred from the Oahu Prison. On admission he was reported to be quiet, coöperative, and depressed. The examining physician said that he was preoccupied, confused and hallucinating. The patient stated that he heard voices at

the prison which kept him awake and that he believed he was crazy. He thought that he had killed two persons in a fight and for this he was sent to jail. The ward notes were to the effect that he was helpful in the ward, confused and depressed at times, but at others played checkers and looked at magazines. He seemed very well satisfied to be at the hospital. He was seclusive and preoccupied at intervals but would always respond when spoken to. According to a statement from the prison, the immediate cause of his transfer was an attack with a knife on another prisoner. At the diagnostic conference, the diagnosis was manic depressive psychosis, depressive type. He was recommended for shock treatment.

At a pre-lobotomy conference held on the 14th of July, 1943, it was stated that an encephalogram was done and showed a normal picture and that shock treatment was not given because the machine was out of order at the time. The patient admitted that he had killed two persons with a knife in a fight and that while in prison he used a knife on another prisoner. He was found to be delusional and subject to unpredictable acts of vicious aggression. Under these circumstances, it was determined to carry out a lobotomy operation in the hope that it would quiet and stabilize him. A psychological report had noted that the pros and cons for operation were evenly balanced and that there was low mentality with anxious, perfectionist responses. The advisability of lobotomy was questioned, although a good maze test record was a good prognostic sign.

The operation took place on the 19th of August, 1943. His behavior immediately prior to the operation was quiet and seclusive, with slow responses. He would do work only when ordered to do so, but did very well once he started. His appetite was good and he made no complaints.

Immediately after the operation, he was reported to be restless, with urinary incontinence. He would tap on the bed rails occasionally and pick at the bedclothes, but on the day following was able to bathe himself and to eat a good lunch and was no longer incontinent. He was still restless in bed and complained of a headache. He found walking very difficult but was willing to take exercise. Other notes included lack of initiative and little interest in his surroundings. He was very lazy and inattentive, but behaved quite well. Later in the month he was still seclusive and was observed masturbating. A note on the 10th of September, 1943, said that he was showing signs of being easily irritated and combative towards anyone who interfered with him. He showed lack of initiative and would sit on a bed or chair for a very long time. He did not mingle with the other

patients nor converse with them. His appetite was good. He occasionally became angry when asked to do any work. The ward notes for September record meticulous reactions and lack of initiative as the two outstanding characteristics. He was lazy at times and there was considerable increase in appetite. Dr. Ozawa noted that while easily irritated, he has not shown any tendency to strike anyone. He believed that he was improved. During October the ward notes recorded preoccupation, meticulous reactions, and lack of initiative continuing.

Psychological Report

This patient, according to the report on his previous history, has had several stabbing affrays and had been convicted of manslaughter. He is very handicapped as regards use of English so that the mental age allotted in the pre-operative examination may not be properly representative of his real ability. For example, the patient knew the order of the days of the week in Filipino, but not in English. However, there were enough failures in tests not dependent on English to indicate rather inferior intelligence.

It was in view of this fact that prefrontal lobotomy was not recommended directly. The patient could not repeat five digits nor give four digits in reverse order, but he was able to make simple change and reproduce the 11-year bead-chain design. His Binet mental age was 7 years 9 months, *IQ* 56.

In the Maze test he made a much better score. He required two trials at 9 years, two at 12, and three at 14 years. The resultant test age was 13 years, *IQ* 93. He was extremely slow and hesitant, very careful, almost meticulous in drawing, and there was at times great difficulty in making a decision. The nature of his responses suggested a perfectionist trend and considerable anxiety. He also showed a tendency to become over-absorbed in the task so that he disregarded instructions not to lift the pencil from the paper while considering the course. In spite of care in execution, the qualitative error score was 34.

With these facts in mind, the psychologist's recommendation was rather hesitant. On the one hand was the low mentality per Binet, which was unlikely to be improved. On the other hand the Maze was sufficiently high as to indicate that some loss in planning ability after the operation would not result in the patient becoming unable to adjust to simple, everyday requirements. The anxiety state, if present, should be relieved, but the manic episodes might not be diminished. A conservative opinion would be adverse to the operation. In making this recommendation, the psychologist may have

allowed the balance to tip on the negative side through putting too much emphasis on the low Binet score.

The post-lobotomy Binet revealed, as was expected, no improvement in mental status. There was, in fact, a loss of 3 months in mental age due to failure to reproduce the bead-chain design. The patient's reactions were even more hesitant than before. In the bead-chain test he evinced this trait of irresolution by threading and rethreading the beads. In trying to draw a design from memory (year 10), he drew a rectangle and then traced and retraced the lines, apparently with the idea of getting them exactly the same thickness.

The Maze test responses after operation were quite typical. He made no errors up to and including the 11-year test, but failed in the allotted four trials in year 12, repeating the same mistake twice. In the 14-year test, failure also was recorded, the patient making the same error three times in succession. This stereotyped response was noted so often that a statistical study of the occurrence of repeated errors was undertaken, with results recorded elsewhere in this paper. The test age was 11 years, a loss of 14 points in IQ level.

The general performance in the Maze was hesitant as regards planning, but careful in execution. The qualitative error score was reduced to 21 points, the improvement being due to the fact that there was less absorption in the task and so instructions received more attention.

As is indicated in the report from the Hospital, the patient seems more coöperative and less troublesome in the ward since the operation. Possibly it is too early as yet to decide the question of permanent or real improvement.

Summary

A manic depressive case, depressive type, with distinct homicidal trends. Possibly paranoid ideas, which lack of verbal expression conceals. Anxiety state probable. Operation not recommended on account of low mentality. Post-operative loss in planning as shown by the Maze test, also stereotyped responses. Improved social adjustment initially observed after operation, but final results not yet apparent.

Q. CASE No. 18

This patient, E— V— G—, a Puerto Rican female born in 1902, was admitted in July, 1926. Shortly afterward, she was reported to be perturbed, noisy, and reacting to auditory hallucinations. She continued to be silly,

delusional, and noisy. Her diagnosis was dementia praecox, hebephrenic type. The following year it was stated that there was no improvement. She spent a lot of time on a bench beating it with her hands and chanting inarticulately. In 1928 deterioration was said to be progressive. The reports continued the same up to 1933, when it was said she was filthy in her habits, combative, emotionally unstable, manneristic, and sexually overactive. She was noisy at night and had attacks of temper, in which she struck other patients. In September, 1942, she set fire to a mattress. The same month an encephalogram was done. This showed an essentially normal brain except that the left ventricle was somewhat larger than the right. A chronic sclerosing mastoiditis on the left side was also noted. At the pre-lobotomy conference on the 18th of November, 1942, the case was summarized as that of a hebephrenic praecox, 40 years old, who had been in the Hospital for 16 years. Her condition had not changed materially during the years that she has been in the Hospital. At the time of the conference she was disoriented and usually very noisy. The psychological report showed that her mental level was low and she was either deteriorated or was mentally deficient as well as being psychotic. She was not considered suitable for lobotomy except for the purpose of institutional stabilization.

The operation was performed on the 17th of December, 1942. Immediately prior to the operation she was noisy but coöperative. She spent much time singing and dancing, and pretended to read magazine articles, uttering a jumble of words without coherency. She continued to be very noisy and kept climbing on the window guard until she went to the surgery. Immediately after the operation she was quiet and coöperative, and spent her time playing with a piece of thread from the bedding and tapping on the side rails of the bed. She repeated conversations going on about her. She kept trying to remove the bandages. She was extremely talkative and was childish in her behavior. There was considerable incontinence. She again pretended to be reading from magazines but without understanding. In the few days following she was cheerful, singing loudly and dancing when music was heard on the radio. She was still incontinent but helped with the sweeping of the ward. She lacked initiative, having to be told to bathe herself, get ready for bed, etc. However, she seemed to be in a better mood and more anxious to be helpful. The ward observations for January included slowness of thought, poor judgment, disorientation, elation at times, fluctuation of attention, lack of initiative, restlessness, stereotyped reactions, and increased appetite. In April, she was still confused, delusional, disoriented,

playful, lacking in initiative, and lazy. At a post-lobotomy conference, it was decided that she talked better and was slightly improved. The latest report in September, 1943, notes that she is profane in speech, hallucinates, has flights of ideas, has ideas of reference, is irritable and restless. So far it is justifiable to say that there has been a slight improvement in institutional adjustment, although she is still restless, irritable at times, and profane.

Psychological Report

This was recognized as a poor case for lobotomy, but the operation was performed in the hope of improving her stabilization within the institution.

The pre-operative examination showed that she possessed very inferior mental capacity, partly the result of deterioration and partly due to mentally poor development. The Binet mental age was considered to be more than 5 years, with very little practical ability. In the Maze test she could not score above a 5-year level.

In the post-operative examination she proved almost completely inaccessible to Binet testing, and on this occasion failed to pass the 5-year Maze test which she had previously succeeded in. In general, her condition following the operation is definitely not improved, though slightly better institutional adjustment has been lately observed.

Summary

A dementia praecox case, hebephrenic type, the psychosis evidently superimposed on a mentally deficient condition. Lobotomy was carried out in the expectation of better institutional adjustment. No significant post-operational improvement, but some loss in mental capacity, with slightly improved stabilization.

R. CASE No. 19

This patient, D— M—, a Caucasian male born in 1914, was admitted to the Hospital on May 14, 1936. He was then reported to be stubborn, resistive, egocentric, with orientation good, but insight very poor. Physically he was in good condition. His mental illness had first become apparent two years earlier when he was working in Washington and had to be returned to Honolulu. At the time of his admission, he was wild, manneristic, hostile, and claimed that he was various important persons. During examination by the psychiatrist, he was very talkative and entertained ideas of persecution, identifying himself with various people of prominence. The diagnosis was schizophrenia, mixed type, the clinical picture resembling both the catatonic

and paranoid types. Under appropriate treatment he made excellent recovery and gained some insight into his condition. He obtained a job as a teacher and in the meantime graduated from the University. He was seen again at the Bureau of Mental Hygiene while on parole and was found to be still schizoid but making a fair adjustment in the community. In August, 1939, he was returned from parole on complaint that he was hyperactive, hallucinatory, and unmanageable. He was given many courses of metrazol treatment but with only temporary improvement for a few weeks after each course. An encephalogram done on the 23rd of July, 1942, showed moderate generalized dilatation of the ventricular system without cortical atrophy, and also possible mild cerebellar agenesis. Immediately prior to the operation his most predominant symptoms were those of a silly, deteriorated, hebephrenic-like individual. He was at this time inaccessible to psychometric examination. He was subjected to lobotomy on the 20th of August, 1942, and the reactions noted immediately afterward were that he was lazy and inattentive, urinated in bed, ate very slowly, and seemed continually euphoric. Later he spent most of his time walking about in the ward and talking very loudly. Still later his reactions were those of a catatonic, as he lay still in bed all day long. He had not gained any weight, and at a post-lobotomy conference on April 30, 1943, he was declared unimproved. For about a month during June and July in 1943—interestingly enough, immediately after a follow-up encephalogram—there appeared one of his remarkable periodic improvements. At that time, he was rational, well oriented, intelligent, with excellent insight. Appetite increased and he was meticulous in his reactions and euphoric in mood. By September, however, he had retrogressed to his former condition of irritability, depression, delusions, disturbances of association, and ideas of reference. The general picture is one of no improvement.

Psychological Report

This patient, when seen prior to lobotomy, was quite inaccessible to mental examination. He was depressed and suspicious and made no attempts to answer questions except to give brief replies regarding dates of attendance at the University.

At the time of the post-operative testing, the patient was in the temporary rational period previously referred to. The examination revealed probable memory loss, the digits-reversed span being only four, the digits-forwards, six. The patient was also unable to interpret proverbs except in a limited and

literal sense. Yet tests of vocabulary, opposite analogies, and ingenuity were passed at a superior adult level. Deficits in immediate memory, especially reversed digit span, have also been noted in other cases, and it is very probable that this loss is attributable to the operation. Literal rather than general application of proverbs is also characteristic of lobotomy patients.

In the Maze test he required three trials at the 14-year level, but otherwise showed no obvious loss in planning capacity.

In view of the suggestion that has been made that lobotomized patients have difficulty in dividing or alternating attention between different activities, the Maze test was repeated within a week under special conditions. Instead of drawing a straight line, the subject was instructed to find his way through the maze making a continuous wavy line. The effect of this division of attention was at once apparent. The patient required two trials in the 12-year design, two in the 14-year, and three in the same test inverted. Considering his familiarity with the test, this comparative failure supports the view that quick alternation of attention from one part of a task to another is adversely affected by psychosurgery.

Summary

A schizophrenic patient, exhibiting both paranoid and catatonic symptoms, inaccessible to testing prior to the operation. After operation, during a rational period, he showed a fairly high level of mental capacity, with typical deficits in mental flexibility. Patient subsequently relapsed into the former negativistic, suspicious, schizophrenic behavior.

S. CASE No. 20

The last case presented in this series, D—H—, a Japanese male, is interesting because of the short interval elapsing between prefrontal lobotomy and the mental examination. Only one week had intervened and thus an opportunity was provided for noting the earliest consequences of the operation.

The patient had at one time been an attendant at this Hospital, and this fact may have had some influence on his behavior, making him harder to manage and more inclined to interfere with the other patients.

Though he was admitted as recently as January 14, 1942, there is a record of mental disturbances going back to a motorcycle accident four years previously, at which time he suffered severe head injuries. He attended the Japanese Hospital for a long period and was reported at that time to be

irresponsible, seclusive, and worried. He became a heavy drinker, was quarrelsome at times, and said he had difficulty in thinking.

When examined first at this hospital, the physician (Dr. Ching) reported him as being untidy, depressed, belligerent, with a continuous stream of talk, but coherent and relevant in content. He thought people were plotting against him and he wanted to see his admission papers to discover who had railroaded him into the Hospital. The attendants reported him to be restless at night and worried over his children, but otherwise quiet and coöperative.

Later ward reports stated that he was very untidy in habits. He threw cigarette butts and matches on the floor, did not want to bathe, and even went to bed with his shoes on. He said that his mental trouble was due to worry over his son who was born feet first and was in consequence subnormal. He took little interest in his surroundings, was depressed, and "acted tough" with attendants and other patients.

Dr. Cloward reported having seen this patient in November, 1941, two months before admission to the Hospital. Neurological and general physical examination revealed nothing abnormal. There was at that time constant irritation and trouble in the family because of the patient's laziness and refusal to work. Alcoholism and the effects of the accident were believed to be contributory causes of his condition. Dr. Cloward thought him to be an early case of schizophrenia.

At a staff conference in April 1942, the patient was diagnosed as "Psychosis with Psychopathic Personality." It was reported by Dr. Ozawa that he was belligerent, had "a chip on his shoulder," and had assaulted another patient about a month before. Parole was deferred but later granted.

For six weeks he was employed at the Coca-Cola factory and then left, complaining of dizziness and headaches. He was returned to the Hospital on August 11th in a similar mental condition as when first admitted. He was seclusive, depressed, unresponsive at times, and believed he had been "framed" and that he should not be confined. The same month he made an unprovoked assault on another patient and wanted to fight the attendant. He continued to be antagonistic and argumentative, and had frequent fights. He tried to read the attendant's charts and notes, and was disturbed and interfering. Electric shock treatments were instituted in November, 1942, followed by another series the following month.

At a staff meeting in December, the patient was reported to be entirely lacking in insight and always demanding release on the grounds that there

was nothing the matter with him and that he should be outside supporting his children. This condition continued into February, 1943, when he was depressed, inactive, brooding, and occasionally bullying and belligerent towards other patients.

On April 3, 1943, he was paroled to a job at the Hawaiian Pine Cannery, where he had been previously employed as a foreman. He was engaged in rough carpentry work but soon became dissatisfied and disturbed. In September, he was again admitted to the Bureau of Mental Hygiene and found to be confused, threatening, and troubled with ideas of persecution. He was then transferred to this Hospital.

An encephalogram report from Dr. Cloward stated that the third ventricle was slightly larger than normal, but otherwise there were no abnormal features. Lobotomy was approved.

Prior to the operation he was quiet, neat in appearance, forgetful at times, lacking in insight, and responsive though restless at times. He was very seclusive and suspicious about the pre-operative preparations. He was observed smiling, giggling, and muttering to himself. His appetite was good. The operation was performed on November 4, 1943.

The immediate post-operative behavior included restlessness, purposeless activity, such as tapping the bedside, attempts to remove bandages. He was active when awake and there was no incontinence. At times he joked with attendants and at others was stubborn and antagonistic.

On November 6th, two days after the operation, he was tactless and playful with a woman attendant, pulling her hair and the back of her cap, giggling rather foolishly as he did so. He was restless at times. He read a little and at other times seemed indifferent to surroundings, staring blankly at the wall.

The next day (November 7th) he brushed his teeth and said he felt fine. He was in a playful mood, smiling and conversing with other patients. He played with a spoon at breakfast and tapped the bedside rail in time with radio music.

On November 8th, he was very drowsy, but quiet and cooperative when awake. He showed childish reactions, putting out his tongue at attendants, trying to attract attention, and laughing. For the first time he did not complain of persecution. The only change recorded on the following day was that he bothered the attendants with unusual and foolish questions. On November 10th, his actions were silly and childish at times, and he made many bids for attention. His appetite was good, he was quiet and cooperative.

tive, but preferred staying in bed to any activity. There is as yet no marked improvement, but it is as yet too early to expect any significant change.

Psychological Report

The pre-lobotomy mental examination was given on the 24th of September, 1943. The patient stated that he had reached the senior grade in high school but did not graduate. His Binet performance indicated some mental retrogression. His English vocabulary was at a superior adult level, but he passed no other of the tests for average adults. He was unable to reproduce simple designs at years 11 and 12, nor could he interpret correctly the absurd picture at year 10, nor reproduce a sufficient number of items from a news paragraph. He also made a very poor attempt in planning out a search in a field for a purse that had been lost. The scattering in tests in relation to the high vocabulary level indicated deteriorative changes. His Binet mental age was 13 years 7 months, *IQ* 97.

In the Maze test he succeeded in all designs up to and including the 9-year on the first trial. He made two rather obvious errors in year 10 and failed in the 11-year design, making an identical mistake on the second trial. His test age, therefore, was 9 years, *IQ* 64.

On the basis of the evidence for deterioration, in addition to poor planning as shown by the Maze test, he was not recommended for lobotomy.

On the post-lobotomy examination, one week after psychosurgery, there was practically no change in the general mental level. He failed all four tests at year 10, but compensated for these failures by two successes at a higher level. The vocabulary range was unchanged, remaining at superior adult level. His mental age was 13 years 1 month. On this occasion he was unable to say five digits backwards, a test in which he had succeeded previously. The mental blocking, which had not been formerly apparent in the word association test, was now quite marked. Formerly, he gave 69 words in three minutes, and on this occasion only 43. There was also loss as regards rote memory, his span having dropped from six digits to five.

In the Maze test he failed in two trials at the 7-year level, repeating identical errors. He passed in the 8-year test then failed at the 9- and 10-year levels. His test score was therefore only 7 years, a drop of two years in test age and 14 points in Maze *IQ*. The quality of execution improved slightly on the post-lobotomy performance, all of the corners being sharply formed, whereas on the previous occasion there was a tendency to make them rounded.

Summary

A case of psychosis with psychopathic personality, the condition appearing after a serious head injury. Operation not recommended by the psychologist on account of evidence of deteriorative changes. Post-operative behavior included laziness, childish behavior, and restlessness. Delusional ideas are, at least temporarily, abated. Some changes in post-operative mental condition include deficits in rote memory and mental flexibility. Maze picture is typical of post-lobotomy patients, with loss in planning capacity and in ability to profit by experience. The question of final improvement is deferred.

III. DISCUSSION OF RESULTS

Having presented in considerable detail the history of each patient since his admission to the hospital, with an outline of his behavior immediately prior and subsequent to psychosurgery, and, in addition, his pre-lobotomy and post-lobotomy mental test results, we may proceed to summarize the data in the endeavor to discover what conclusions, if any, emerge. We shall first consider the mental changes that our group of patients display.

The approach to an estimation of the general intelligence of our subjects was through a modified form of the Terman-Merrill revision of the Binet tests, a composite of Forms *L* and *M*, as used in the Psychological Clinic of the University of Hawaii. Quite apart from the usual difficulties experienced in testing psychotics, mainly related to the varying degrees of their accessibility, the Binet possesses certain disadvantages. The application of a heterogeneous collection of tests tends to increase certain patients' distractibility. In tests of a uniform nature, where a single goal or a single mental activity is to be kept in mind, the interest of the psychotic subject is more closely held. It is easier for him to stick to the point. But when the examiner skips, for example, from a vocabulary test to drawing designs from memory or to the interpretation of an absurd picture, fluctuations of attention or effort frequently occur that seriously affect the results. The tests then appear to the subject to be rather pointless mental exercises of a controlled nature, when the patient's attitude is adverse to either exercise or control. In short, the difficulties in the way of applying tests to any adults are exaggerated when we deal with the psychotic. For these reasons the experienced psychologist would be the last person in the world to rely too heavily on such things as mental ages and *IQ*'s obtained in this way, or to attribute to the results an objectivity which they scarcely possess. Nevertheless, this does not mean that test measures are robbed of all significance. The evidence is not wholly reliable, but it is the best and most objective attainable, and decidedly better than none.

On the other hand there are certain advantages of the Binet that justify its use as a psychometric measure of the ability of lobotomized patients. Chief of these is the general familiarity of psychologists with the instrument, making the interpretation of its results more significant. Disparate single tests as used by some observers merely constitute a hodge-podge. Not only do such arrays of poorly correlated tests suffer from lack of interest and poorly sustained effort on the part of the subjects, but the results often obtained are practically valueless because no one knows what they mean.

The variety of tests in the Binet scale enables the examiner to note inequalities of performance which may indicate either specific abilities or possibly deteriorative changes. In any case, the disadvantages of the Binet as a testing instrument are likely to affect both pre- and post-lobotomy applications equally. With some patients the similarity of responses in successive examinations is often quite striking. Even after an interval of months, vocabulary definitions are often couched in identical terms, while word associations often fall into the same sequential patterns. In the hands of cautious and experienced examiners, the Binet has undoubted value as a psychometric instrument, especially for the type of study dealt with herein.

The most obvious conclusion from a survey of our results is that there is no consistent picture of general mental impairment, or the reverse, arising from lobotomy. In spite of repeated statements by other observers that the operation does not bring about any serious intellectual deficits, we have found declines of respectively 22, 19, 14, 13, and 11 points of Binet *IQ* in five of our series of 20 patients. On the other hand, one gain of 18 points and a number of small gains, due no doubt to the greater accessibility of patients, were recorded. Most of these changes are not within the ordinary variation of scores in successive testings. In this respect our findings disagree with those of Kisker (8) in one of the latest psychological reports on the subject. He comments on "the absence of measurable post-operative intellectual change" and the "failure to find intellectual impairment."

We are, however, in much more complete accord with his further statement that "from a therapeutic point of view, intellectual changes are relatively unimportant." Such changes as we have observed do not seem to be related to the degree of improvement, and even the largest deficits may not be decisive in determining whether or not a patient, if recovered from the psychosis, will be able to earn a living on discharge. A deficit may, however, affect the level of industrial self-support. Our first case, for example (*W—C—*), is able to support himself on a barely marginal or submarginal level in an extremely simple occupation. This industrial restriction as a result of psychosurgery, however, is relatively unimportant beside the fact that the patient has been relieved of dangerous criminal tendencies that dominated his behavior for about 40 years. Doing rather inefficient work in the community is vastly preferable to doing better work inside a prison, or no work at all in a mental hospital.

Summing up the general Binet results, we find that the average *IQ* of 18

patients with pre-operational test records was 84 points ($SD_{dist.}$ 24.9 points). The post-operational average IQ was 81 ($SD_{dist.}$ 19.4 points). Hence, there was an average loss of 3 points in IQ score. Because of the small size and variability of our group, these figures are of little significance as regards prognosis in individual cases. The figures are given in Table 2.

TABLE 2
CHANGES IN BINET TEST LEVEL OF LOROTOMIZED PATIENTS

Case No.	Pre-operative score		Post-operative score		Difference	Condition*
	Binet age	IQ	Binet age	IQ		
1	14- 7	104	12- 6	90	-14 points	Much improved
2	20- 3	135	17	113	-22	Unchanged
3	12- 6	87	12- 9	91	+ 2	Slightly improved
4	14- 6	100	13-10	95	- 5	Worse
5	7	50	7-11	68	+18	Much improved
7	9-10	67	8- 6	61	- 6	Unchanged
8	11- 6	82	12- 2	87	+ 5	Improved
9	9- 9	70	10- 1	73	+ 3	Paroled—Improved
10	12- 3	88	9- 6	69	-19	Improved
11	11- 9	84	11- 1	80	- 4	Much improved
12	10-10	77	11- 4	81	+ 4	Unchanged
13	12- 9	91	11	78	-13	Unchanged
14	9- 6	66	10	71	+ 5	Improved
15	12	86	10- 6	75	-11	Unchanged
16	20- 2	134	20- 5	136	+ 2	Slightly improved
17	7- 9	56	7- 6	54	- 2	Slightly improved
18	5	36	5	36	0	Unchanged
20	13- 7	97	13- 1	94	- 3	Slightly improved

*Based on last report.

Though it would be hazardous to formulate any generalizations on such a body of data, one conclusion seems reasonably certain. It is that in a heterogeneous series of cases, trends as regards deficits are likely to be concealed on account of pre-operative mental structuring. When the psychotic attitude is improved, gains in IQ level may be registered by patients whose previous performance was inferior. The tendency for those who scored initially at a high level in such a test as the reversed digit memory span is to come down. This tendency is obscured in the general picture by the improvement of those who initially scored too low and whose attitude to the test has improved. Two patients with the highest spans (5 and 6 digits reversed) both declined. Of those with a four-digit span, one declined and three remained the same. Five cases who improved post-operatively were all testing at the initial low level of a three-digit span.

The same tendency is observable as regards vocabulary and word asso-

ciation. Some, whose psychotic condition interfered with performance before operation, improved; those with initially high levels of response showed some impairment. Thus there is a tendency, not apparent on the average, for lobotomized patients to approach equalization at a mediocre level of performance. It would be interesting indeed if the effect of generally applied lobotomy would be to reduce the human species to a dull level of mediocrity. This tendency to equalize abilities does not apply, of course, to the mentally deficient. No operation can put into the defective brain what isn't there.

When, however, we turn to the consideration of the post-lobotomy changes in Porteus Maze test performance, we are no longer on uncertain ground.

For those not familiar with the Maze test a word of description may be useful. In working through the maze designs, which are graduated in difficulty at age levels from five to fourteen years,⁶ the subject is confronted again and again with a choice of direction, success being mostly dependent on prudent preconsideration and the selection of a course of action that does not lead to a blind alley. Since a similar situation recurs so often, the test becomes one of prudence and forethought and ability to profit by experience. This latter feature is emphasized by a system of allotting repeated trials—two to each design except those for 12 and 14 years, in which four trials are allowed. Penalties in scoring are attached to every error.

For some reason, not readily apparent, the Maze test is accepted by adults who frequently reject other tests as childish or irrelevant. Weisenburg, Roe, and McBride (12), in their study of indigent adults, report that it was well received. This was also the experience of examiners who used the Maze for individual diagnosis of recruits in this war and the last. Even primitive people and savages, whose interest in such things is notoriously hard to capture, not only accept the Maze test with alacrity, but are usually most earnest and even over-anxious in their desire to solve the problems. This was the experience of Dr. Cora DuBois with the natives of Alor in the Timor Sea, of Fry and Pulleine with Central Australian aborigines; of Stewart with Borneo sea-gypsies and with aboriginal Sakai in Malaya; and of one of us (Porteus) with the Bushmen of the Kalahari, with other natives of South Africa, and the aborigines in the northwest of Australia. If psychotic patients are reasonably accessible, they rarely fail to be interested in the Maze.

⁶An adult design was not applied.

Correlation studies published some years ago have shown that lack of initiative and inferior planning ability are most closely related to poor performance in the Maze, though impulsiveness, or its converse, irresolution, as well as suggestibility and "nervousness" are also responsible for errors (10).

In observations relating not only to our own series of cases, but also in reports by others, lack of initiative and poor planning ability are repeatedly commented upon as being characteristic of the lobotomized patient. So frequently is this the case that "planned initiative" has been suggested as one of the chief functions of the frontal lobes. "With the intact brain," say Freeman and Watts, "the individual is able to foresee, to see before, to forecast the results of certain activities that he is to initiate in the future. And he can visualize what effect these actions will have upon himself and upon his environment. . . . A patient with intact frontal lobes can presumably define the goal towards which he is working, and estimate more or less clearly the nearness with which he is approaching it" (4).

We have previously suggested that part of the failure in Maze test performance is due to the patient's inability to successfully divide or alternate attention between two activities.⁷ This seems to be one of the outstanding results of lobectomy. Quoting Jacobsen's experiments with lobectomized animals, Freeman and Watts say: "As a positive deduction, one might state that the function of the frontal lobes is to retain in consciousness, simultaneously, a number of concepts differing in temporal relationships." This function is also related to synthesis, planned initiative and social sense, deficiencies which were observed by Bianchi as following lobectomy in monkeys.

This difficulty of dividing attention has already been referred to in reports on the first case in our series. Apparently when the subject arrives at a "choice point" in the maze, he finds it difficult to transfer attention from guiding his pencil carefully through the maze to the eye movements necessary for the mental tracing of the course in advance so as to foresee whether it leads into a blind alley. The more meticulous the patient has become in the execution of a task, the more likely he is to fall into error. Normal individuals do not appear to suffer the same difficulty. Describing a very recent application of the Maze test to the problem of selecting factory foremen, Gibbons (6) says, "The Porteus mazes were used as a potential measure of planning ability or foresight. The results showed that the more times the subject stopped during his performance, the better is his success

⁷Difficulties in alternating attention were noted in one of the first publications on the Maze test in an article in the *Journal of Psycho-Aesthetics*, June, 1915.

as a foreman." Thus a pause in the motor activity of drawing while attention roves in search of tentative solutions or in a mental rehearsal of next steps is an indication of careful planning.

The neurological basis for this poor capacity to successfully divide attention is probably due to inferior brain organization. Eye movements and hand movements are mediated by different areas of the motor cortex, visual perception and interpretation by other areas, while the coordinating center in specific goal-seeking may well reside in the frontal lobes. One suggestion is that these lobes contribute the most important factor in the ability to hold in consciousness a realization of the degree of progress towards the solution of a problem (nearness to a goal), while attention is directed towards the next steps. Only in the frontally intact, well-organized brain can this dual representation, this momentary splitting of the ego take place.⁸ The brain of the feeble-minded is not sufficiently well organized for this division of attention; the lobotomized patient has had this capacity for organization impaired. Even if it is a matter of swift alternation of attention while still keeping an end in view, rather than the maintenance of two focal points of attention, a brain well organized with rich interconnecting subcortical neural pathways will still be necessary. The inferior capacity of the mentally defective for planning is shown by the fact that of over 800 cases in our Clinic files with Binet *IQ*'s below 65 (a first presumptive proof of feeble-mindedness), 85 per cent had Maze *IQ*'s below 70.

Freeman and Watts report the case of a telephone operator who after psychosurgery could complete calls with better than average success but who failed in 30 per cent of instances to carry out the rather simple requirement of recording each call by pushing a button. It would seem that the temporal factor emphasized in Nichols and Hunt's study would not be as important as holding in consciousness the idea that the goal had not been completely attained. Lobectomized monkeys also fail to solved problems when all elements are presented simultaneously. If the temporal factor were so important, then all capacity for sequential responses would be lost. Thus new learning would become impossible, which is apparently not the case, even in lobectomy.

The results of the repetition of the Maze test after operation demonstrate very clearly the loss in planning capacity and initiative. Out of 17 cases

⁸For this concept of the ego as "the conscious, perceiving, responding, anticipating, planning, experiencing individual at any given period of his existence," see Porteus (11, p. 466 ff.).

with pre-operational records, only two showed any gain in Maze *IQ* after psychosurgery, in spite of practice effects. In one of these patients (Case 3), the operation was not followed by the disorientation and mental confusion which according to Freeman and Watts indicate adequate surgery. The operation was therefore repeated. In spite of the fact that this patient was now, after four other applications, quite familiar with the maze series, he registered a decline of 11 points in Maze *IQ* from the previous examination and a loss of 8 points compared with the pre-operative record. He also showed the psychomotor retardation typical of lobotomized patient's performance. It is perhaps noteworthy that the other patient who showed a gain in Maze *IQ* level also failed to exhibit the typical operational sequelae in general behavior.

In order to show the significance of the above findings, a control group, consisting also of 17 cases over 14 years of age, all of whom had had a repeated application of the Maze test, was drawn at random from the Clinic files. The results of the comparison with 17 lobotomized patients are shown in Table 3. Reference to these figures will show how abnormal the situation is as regards the latter group. Seventy-one per cent of the Clinic cases gained on a second application, indicating practice effects, the average improvement being about two years of test age. Two of the three individuals who declined in test age were feeble-minded. On the other hand, only one case, or 6 per cent of the lobotomized group, gained on the second application of the Maze. The average loss in test age amounted to approximately two years.

The question now arises as to whether this impairment may not have the effect of reducing the lobotomized patient to a feeble-minded level. But it must be remembered that the patient usually retains his general intellectual capacity, and that is high enough to differentiate him from the mental defective. While this is true, the similarity of the maze performance of feeble-minded and lobotomized has considerable significance.

Because planning ability suffers such a decline after psychosurgery, the temptation is strong to consider this as one of the chief functions of the pre-frontal regions. From what we have already said, it should be clear that we regard the effect of the operation as disruption of inter-regional coordination rather than as loss of any localized function. Some coordinated cortico-thalamic activity is still possible for lobotomized patients because it is probable that only about 80 per cent of the subcortical connections with the prefrontal regions are severed in a successful operation. There still remain effective,

TABLE 3
RESULTS OF REPEATED MAZES—CLINIC AND LOBOTOMY CASES

Clinic cases				Lobotomy cases							
Case No.	Age	Test score	Interval	Test score	Diff.	Case No.	Age	Test score	Interval	Test score	Diff.
1	14-6	11	8 yrs.	12	+1	1	57	11	2¾ yrs.	7	-4
2	14-6	11	4 yrs.	14	+3	2	38	14	7 mos.	11	-3
3	15	10	13 yrs.	13½	+3½	3	39	14½	1 yr.	13½	-1
4	14-11	10½	4 yrs.	14	+3½	4	64	6	3 mos.	5	-1
5	15-9	10	1½ yrs.	10	0	7	25	13	3¾ yrs.	8½	-4½
6	18	8	4 yrs.	8½	+½	8	28	14	7 mos.	9½	-4½
7	15-9	5½	2½ yrs.	10½	+5	9	41	6	9 mos.	6	0
8	28	7½	2 yrs.	11	+3½	10	32	13½	9 mos.	8½	-5
9	41	8½	2 yrs.	7	-1½	11	41	14	4 mos.	10½	-3½
10	15	16	3 yrs.	16	0	12	36	8½	6 mos.	8½	0
11	14-3	13	½ yr.	14½	+1½	13	36	12½	10 mos.	11½	-1
12	14-4	13½	2½ yrs.	13	-½	14	20	13½	2 mos.	14½	+1
13	18-11	16½	3 yrs.	17	+½	15	45	11½	3 mos.	9½	-2
14	14-3	4	13 yrs.	9½	+5½	16	34	14½	3 mos.	14½	0
15	14-2	9	2 yrs.	14	+5	17	28	13	2½ mos.	11	-2
16	42	7	4 yrs.	6½	-½	18	38	5	11 mos.	4	-1
17	16-4	8	6 yrs.	11	+3	20	33	9	1½ mos.	7	-2

Seventy-one per cent of cases improved on second application. Net gain 1.94 years.	Six per cent of cases improved on second application. Net loss 1.97 years.
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Seventy-one per cent of cases improved on second application. Net gain 1.94 years.

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though long-circuited, communications through inter-gyral fibers underlying the cortex and through fiber bundles near the base of the brain and others running through the corpus callosum. At the same time the general organization of the brain must be adversely affected though the patient may retain intact circumscribed circuits of response involved in abstract abilities such as arithmetical computations or vocabulary definitions.

In view of the facts that the frontal lobe cortex is left practically untouched and that communication with other parts of the brain is mainly affected, it would be hazardous to base conclusions as to the functions of the frontal lobes on the effects of severing their main subcortical connections. Frontal lobectomy should provide much more definite evidence on this matter.

Another important problem is the question of permanency of the loss in planning signified by decline in maze test performance. In order to determine this matter, a second maze test reexamination was given to 13 of our cases who were available for testing. The results are presented in Table 4. In considering these figures, the marked effect of practice on non-lobotomized cases, even when years instead of months intervene between applications, should be borne in mind. This improvement is not due so much to increased familiarity with specific designs, but rather to a different mental set or attitude towards the test. It no longer represents a test of adaptability to a *new* situation. Those who are capable of learning the lesson have found out that caution and preconsideration pay.

It will be seen, by reference to Table 4, that only in five cases was there any improvement on the last examination over the first post-lobotomy test, even though in some cases this was the fourth or fifth application of the Maze. In only one case was there a gain over the pre-lobotomy record. The post-operational X-ray of this patient indicated that the superior quadrant on one side had not been incised adequately, and a reoperation has been planned. It will be interesting to see whether this will have the same effect in depressing the maze score as it had in Case 3.

One neuropsychological theory that may require revision in the light of the results that follow lobotomy is that the cortex, particularly that of the frontal lobes, exercises an inhibitory function as regards impulses arising from the "lower" emotional centers. Leaving on one side the fact that the lower centers are possibly more necessary to survival than the upper, we doubt very much whether *inhibition* is the most truly descriptive term. The relation of the function of the cortex to emotional impulses is one of only partial control. What the cortex does control is the voluntary muscles.

TABLE 4
POST-LOBOTOMY MAZE TEST REPETITIONS

Case No.	Pre-lobotomy		First post-lobotomy		Second post-lobotomy		Final diff.	Retest interval
	Test age	IQ	Test age	IQ	Diff.	Test age	IQ	
1	11	79	7	50	-29	7*	50	3 weeks
2	14	100	11	80	-20	14	100	4 months
3	14½	104	15	107	+3	13½**	96	6 months
5	—	—	9	64	—	7	50	8 months
6	—	—	5	36	—	6½	46	11 months
7	14	100	9½	68	-32	8½***	61	5 months
8	14	100	9½	68	-32	11½	82	3 months
10	13½	96	8½	61	-35	7½	54	8 weeks
12	8½	61	8½	61	0	10½	75	8 weeks
13	12½	89	11½	82	-7	10	71	5 weeks
14	13½	97	14½	104	+7	13½	97	5 weeks
17	13	93	11	79	-14	8½	61	5 weeks
20	9	64	7	50	-14	9	64	3 weeks

*Fourth application of test.

**Score after reoperation—fourth application of test.

***Fifth application of test.

The soldier may steel himself against the realization of danger and march up to the cannon's mouth when all his instinctive reactions would impel him to flight; but he still feels fear. The transfer of attention to action diminishes this fear but does not inhibit it entirely. If the cortex had this inhibitory power, the soldier might be able to sit still and lose all sense of danger, but this is not the case. The cortex exerts an initiating rather than a mere braking function. It counteracts rather than inhibits (7, pp. 337 ff.).

The effects of lobotomy lend strong support to the contention that we should put the emphasis on interaction rather than control. It is most significant that cutting the cortico-thalamic fiber radiations does not by any means open the flood gates of emotion. Evidently, if there is a controlling mechanism, it can operate otherwise than through the cortico-thalamic connections. In certain cases the reverse process to release of emotion is observable. Impulsive, excitable reactions become less apparent in behavior. In this respect our observations agree with those of Kisker, stated as follows:

Considering the widely held view that the cortex maintains an inhibitory function over the activity of the diencephalon, it is of interest to note that lobotomy is not ordinarily accompanied by chaotic emotional release. Rather, there appears to be a re-distribution of emphasis in the emotional sphere. Some lobotomy patients tend to show an increase in emotional responsiveness following the operation, while others show a decrease in this type of behavior. Apparently the important factor, here, is the effect of pre-operative and pre-psychotic personality residuals. However, this may be, it is a generally accepted fact, thoroughly substantiated in our work, that one basic factor in post-lobotomy personality status is the re-canalization of emotional energy.⁹

"Re-canalization" is akin to what Moniz considers must take place after the disruption of "cellular connecting groups which have become more or less fixed," the mechanism of the fixation process having been suggested by us in our discussion of circuits of response.

On the functional side, our summarization of the situation has stated that behavior may be over-emotionalized, as when every thought or contemplated action is tinged with hopelessness, depression or fear; it may also be over-intellectualized, by a too lively anticipation of dangers, or "a chip on the shoulder" attitude—a disposition to look for causes of offense, due to a too sensitized social sense. If the mechanical theory put forth by one of us (Porteus) as to mode of fixation of circuits of response—enmeshment

⁹Kisker's contribution appeared subsequently to the writing of the major portion of this paper.

of neuronic filaments through contractility—should be accepted as a plausible working hypothesis, then the patient's condition may be considered psychogenic in origin but with resultant organic effects. It is these organic effects which are changed by lobotomy, making possible the formation of new emotional-intellectual attitudes dependent on re-canalization, or the establishment of new neural circuits of response.

For the happy moron who neither foresees nor fears the future, or for the shiftless person with so little initiative that he considers action so long that he never "gets around to doing anything," lobotomy has nothing to offer; it would be painting the lily. But for the over-anxious or the impulsive, the operation promises much. Even if it should tend to draw these individuals together in a state of mediocrity, it is a happy mediocrity at that.

The evidence that planning capacity is affected by psychosurgery is definite enough, but can we demonstrate equally by tests the loss of initiative? The Maze test provides some light on this question also.

In our case reports reference has been made to the tendency of lobotomized cases to repeat identical errors, often in successive trials in the Maze. In order to discover how exceptional this is we have compared the records of the group with those of two other groups of cases drawn from the Psychological Clinic files, and consisting of very dull and feeble-minded individuals, delinquents, and a third group of normals. Table 5 gives the results in

TABLE 5
REPETITION OF ERRORS ON THE MAZE

Group	No. of cases	Total errors	Average	Total repeated errors	Average	Per cent
Normals	100	238	2.38	16	.16	6.73
Delinquents	100	408	4.08	33	.33	8.10
Feeble-minded	50	302	6.04	37	.74	12.25
Lobotomized	18	109	6.00	32	1.78	29.36

terms of the total errors, the total repeated errors, and the percentage that the latter is of the former. The strong tendency of the lobotomized patients to make stereotyped reactions, when failure has already resulted, is clear. Even when a certain response has been penalized they lack sufficient initiative to form and carry out a different plan of action. They are slow to adapt, so that routine responses are difficult for them to avoid.

Though the average number of errors is about the same for the very dull and feeble-minded group as compared with the lobotomized, the percentage

of repeated errors in the latter is $2\frac{1}{2}$ times greater. A check on the pre-lobotomy records of the same patients shows that the tendency to repeat errors is only slightly worse than normal. Hence, repetition of errors is definitely one of the effects of lobotomy and can be ascribed to lack of initiative, an unwillingness or tardiness to try new approaches to a problem.

At a low-level or thoroughly familiar industrial occupation this tendency to stereotyped reaction would probably be no great handicap to the individual. Again, where the prepsychotic condition was one of high intelligence, the tendency might be compensated for. One of the marks of an intelligent person is that he is fertile in expedients; indeed, the most generally accepted definitions of intelligence are usually based on some idea of adaptability to new situations. If there is some loss in this direction in lobotomized patients, it will not, in such cases, be decisive. The learning of new tasks of a somewhat circumscribed nature may still be possible, but situations involving new general adaptations will probably be outside their scope.

IV. THERAPEUTIC ASPECTS

Any summation of the therapeutic values of prefrontal lobotomy in our series of cases must be undertaken very cautiously. In the first place, our group was small; in the second, it was decidedly heterogeneous, from the points of view of mental capacity, degree, and type of psychosis. In some cases the operation was performed with small expectation of marked success, the utmost hoped for being some degree of emotional stabilization, making for better adjustment within the institution. In several cases the psychologist's recommendations were adverse to the operation. Since there were no established criteria for the selection of patients, lobotomy was carried out nevertheless, with a view to testing the validity of these recommendations. Table 6 summarizes the situation.

Eleven of the 20 patients studied have improved to a greater or less degree, two of them to such an extent as to warrant their release from the Hospital. In nine of these cases the psychological recommendation, on the basis of present experience, would have been favorable to operation. In seven of the nine unimproved cases the recommendation would be adverse. Thus, in 80 per cent of cases the prognosis based on various psychological considerations was justified. With more experience this percentage should increase.

The guiding principles in selection may be stated as follows:

1. The elimination from the list of prospective lobotomy patients of the mentally defective on the ground that the operation cannot put into the brain what was never there.
2. The elimination of the mentally deteriorated on the grounds that the operation cannot restore what is already lost.
3. A reasonably high Maze test record is a favorable sign, the reason being that, if planning capacity is diminished, as it almost certainly will be after operation, the individual will retain enough to enable him to function satisfactorily in community life.
4. One conclusion, admittedly somewhat tentative, is that hebephrenia should be considered a contraindication for operation. This feature of behavior is probably to be interpreted as an emotional retrogression, similar in its unfavorable implication to mental deterioration.
5. Theoretically, certain catatonic types, because of the strong tendency to stereotyped reactions in post-lobotomy behavior, would also not be considered good prospects.
6. Another presumption is that manic-depressives exhibiting cyclical

TABLE 6
THERAPEUTIC SUMMARY

Case No.	Diagnosis	Post-operative condition	Psychologist's* report
1	Dementia Praecox	—Paranoid Type	Recommended
2	Dementia Praecox	—Paranoid Type	Recommended
3	Dementia Praecox	—Paranoid Type	Recommended
4	Involutional Depression	—Catatonic Type	Not Recommended
5	Dementia Praecox	—Paranoid Type	Recommended
6	Dementia Praecox	—Paranoid Type	Not Recommended
7	Psychosis with Mental Defect	—Simple Type	Recommended
8	Dementia Praecox	—Depressive Type	Recommended
9	Manic Depressive	—Depressive Type	Recommended
10	Manic Depressive	—Paranoid Type	Recommended
11	Alcoholic Psychosis	—Depressive Type	Recommended
12	Manic Depressive	—Catatonic Type	Not Recommended
13	Dementia Praecox	—Paranoid Type	Not Recommended
14	Dementia Praecox	—Manic Type	Not Recommended
15	Manic Depressive	—Paranoid Type	Not Recommended
16	Dementia Praecox	—Manic Type	Recommended
17	Manic Depressive	—Hebephrenic	Recommended
18	Dementia Praecox	—Mixed Type	Not Recommended
19	Dementia Praecox	—Psychopathic Personality	Recommended
20	Psychosis	—Psychopathic Personality	Not Recommended

*Plus signs indicate cases in which the psychologist's prognosis was correct.

changes in mood are not good risks. The operation cannot be expected to bring about opposite results in the same patient.

7. One commonly dependable post-operative index of the surgical adequacy of the operation is decline in Maze test ability. The results of several reoperations will show whether this indication is completely reliable.

As has been already mentioned, some of the above selective principles are merely indicative. At present writing it would seem that the general diagnostic label attached to a case is not of great assistance. Success has been achieved with various types of psychotic patients, including the psychoneurotic, the schizophrenic, those with obsessive tension states, and involutional depressives.

In relation to the findings of the neurosurgeons who have had the initiative, not only to introduce the Moniz operation to America, but also to extend and improve the surgical procedures, and whose careful reporting of results has been so illuminating, it should be emphasized that the Kaneohe group of patients do not represent fairly the types of cases for which lobotomy is recommended. As we have seen, hebephrenic and deteriorated patients have been included as well as other chronic cases for whom the expectation of improvement did not extend beyond the prospect of quietening their manic behavior so as to make them more manageable within the institution. This is, however, rather inevitably, the kind of program which will be undertaken in many state institutions for the insane.

The fact that improvement followed operation in many of these unpromising cases is all the more striking. Among the criminal insane operated upon were three individuals whose collective convictions included three killings and five stabbings. All were improved and one was discharged as being no longer a menace to the community. Other extremely dangerous patients have become quite amenable and easily managed.

It should also be remembered that improvement in social adjustment is in some cases, as Freeman and Watts point out, a slow but continuing process, extending into the second year after operation, and even through a longer period. In many of the Kaneohe group the post-operative period has been altogether too short to admit of a final appraisal of results. Reoperation also is recommended by Freeman and Watts for patients who do not show the expected improvement. Some of our cases were so unpromising that further operative procedures did not seem worth while. Others who were classified as unchanged after operation might, quite conceivably, have benefited by further psychosurgery.

Our case reports show that in some instances lobotomy was performed when the psychological recommendation was adverse. The criteria of selection are, of course, far from being fully established, and so a few of these chronic cases were included on the theory that their situation was hopeless anyway and that we might learn just as much from our failures as from our successes. In some of these instances the patients' families were anxious to have the operation performed.

For all of these reasons the fact that in Hawaii only about 60 per cent have improved through psychosurgery as against 82 per cent reported from mainland U. S. A. should not be given too much weight. With spectacular results following in so many instances, there is a great danger that lobotomy may become too popular. Pressure from relatives of patients asking for psychosurgery is bound to increase. It is devoutly to be hoped that the application of prefrontal lobotomy will not become widespread until careful and continued psychological and psychiatric studies of its effects have been undertaken. To this end, then, there would seem to be an urgent need for the establishment of a neuropsychological institute, where such an investigation could be adequately carried on. Millions of dollars have been devoted to medical researches that are, from the standpoint of human betterment, much less promising than prefrontal lobotomy.

Both war and postwar conditions are sure to add tremendously to the mental strain imposed on the population of this and every other country. There will be many thousands of individuals who, because of bereavement, worry, over-work, industrial dislocation, and actual losses and injuries, are going to be fear-ridden and anxiety-stricken to the point of social and mental despair. As far as the present evidence goes, these are precisely the types of individuals for whom psychosurgery offers most relief. But before these cases press forward demanding neurosurgical attention, it behooves us to so extend and amplify research that an honest assessment of all the benefits and disadvantages of lobotomy will be achieved. This is a task that calls for the best kind of psychological, psychiatric, and neurosurgical coöperation.

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A TWIN-CONTROLLED EXPERIMENT ON THE
LEARNING OF AUXILIARY LANGUAGES . . . 117

By BRONSON PRICE, WENCEL J. KOSTIR, AND W. MARK
TAYLOR

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A TWIN-CONTROLLED EXPERIMENT ON THE LEARNING OF AUXILIARY LANGUAGES*

BRONSON PRICE, WENCEL J. KOSTIR, AND W. MARK TAYLOR

The Ohio State University, Columbus, Ohio

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1. INTRODUCTION

This paper presents a method of studying the comparative ease of learning of two languages. It consists in using selected pairs of "identical" twins as the learners. Maximum advantage is thus taken of the fact that, if one can start with closely equivalent and closely correlated groups, very few subjects are needed for clear-cut results. The saving of time is such as should make possible a variety of language learning tests which could not easily be carried out by other methods.

The advantage of using subjects whose initial abilities are highly correlated has long been known, but, presumably because large groups of students are so available to academic researchers, the method has been utilized very little. For comparative learning work in which the total time requirements are small, there is, in fact, little or no advantage in using twins as subjects. This is because it is usually feasible to arrange for the use of two large groups of student subjects, and so to organize the work that one or two class periods will suffice to complete the learning tasks. (As reported in Appendix II, a procedure of this kind was used by the present writers to compare degrees of initial success in the two tasks which our twin subjects undertook more intensively.)

However, difficulties are encountered when this method is used to study the comparative rates at which two languages may be learned. It is most difficult to hold two large groups of persons at tasks requiring weeks or months of time. Motivation cannot easily be controlled, and there are the inevitable absences of some of the subjects; such absences may involve selective factors which render the groups less comparable than they were at the beginning. The method of using large groups may thus be utilized when it is desired to test only for the existence of a crude difference in the ease of learning of two languages. But where highly controversial points are at stake, the investigator can employ whatever research funds he has more efficiently¹ by using selected pairs of twins than by expending the same resources upon a project whose design necessitates large groups of learners.

¹In terms of "critical ratios," the situation may be judged as follows. Suppose that one had used for a comparative learning experiment five pairs of identical twins correlating .97 in ability, and covering the same variability as that of the population concerned. Then, if the difference in the final averages for the two groups of five learners each was found to be just significant, or to show a D/σ_D of a little over 2.0, it would require at least 100 learners in each of two groups to reveal the same difference equally well, if ordinary (that is, uncorrelated) groups of learners were employed.

(The costs of clerical and scoring work alone, of course, are by no means small in comparative learning experimentation which uses large groups).

Although the twin technique is equally useful for comparing the effectiveness of *two different methods* of teaching one language, we wished to test the learnability of an auxiliary language having the "schematic" emphasis, as compared with the learnability of an auxiliary language having the rival "naturalistic" emphasis. Pains were therefore taken to keep the *method of teaching as constant as possible*, in order that the results might reflect only such differences as existed between the two languages.

II. PROCEDURE

Our procedure was set up to require no "homework" of the subjects. Since all active learning took place in the presence of the experimenter, fairly complete records of what occurred during the learning process were possible.

Using the expressions "schematic" (*Sc*) and "naturalistic" (*Na*) to identify both the respective learners and the languages they were learning, the procedure used can be made clear as follows:

For each sitting with a twin pair, there were prepared two typed copies of the *Sc* rendering of a learning passage, and two typed copies of the *Na* rendering of the same learning passage (see Appendix III).

Working alone with, say, the *Sc* twin, one copy of the *Sc* rendering was given to him while the carbon copy was kept before the experimenter. The subject then attempted the English translation of the passage, giving his version orally, and consulting the experimenter as his dictionary and grammarian.

As this proceeded, the *words and constructions which the subject was unable to translate by himself were marked by the experimenter on his (carbon) copy of the passage. When the oral translation of a sentence was satisfactorily completed, the subject wrote it down on his copy directly under the lines for which his words were the translation. The passage had been typed leaving three spaces between lines to provide room for this.*

The same procedure was followed soon afterward with the other member of the twin pair, using the two typed copies of the *Na* rendering of the passage. For each subject, time was recorded at the start and at the completion of the sitting.

HYPOTHESIS TESTED

Drill in word formation and grammar was given continually and naturally in connection with the constructions actually occurring in the passages. Occasions for this drill were more frequent with the *Sc* materials than with the *Na* materials, and this accounts in largest part for the longer times taken on the *Sc* passages. This difference in method was, however, not one of kind, but only of amount, and was necessitated by features intrinsic to the *Sc* language. The hypothesis tested did not concern the fact of the greater difficulty of the *Sc* language in the beginning stages of the learning. With that assumed, the question was *whether*, in terms of time required and errors made on materials of virtually identical content, *the logical features inherent in the Sc language would soon enable its learning rate to approach that for the Na language.*

UNITS OF MEASUREMENT

We had thought at the outset that it might be well to keep time spent on each passage, as well as content of the passage, constant for the *Sc* and *Na* learners in a pair. One could, theoretically, arrange to obtain measures in terms of either (*a*) amount learned per given time or (*b*) time spent per given amount to be learned. After the first three sittings, however, we decided against trying to force matters into either of these types of units. Units of the first type would have been unnecessarily restrictive, and would not have allowed the subject a sense of "closure" through completing each passage to his own satisfaction. Units of the second type were not feasible because there could be no adequate measure of amount learned until the end of the experiment.

Refinements in learning units were therefore not undertaken in this experiment. The subject was required simply to keep busy with the passage at hand throughout each sitting. The *time* recorded for each passage included time spent on re-reading, and on questions which came up after the English translation of the sentences had been written down. From the notations made on the experimenter's carbon copies of the passages, *errors* were counted for words which were guessed wrongly or could not be guessed at all, and also for constructions which the subject failed to grasp by his own efforts. Minor mistakes on points which the subject showed that he knew well enough when prompted for an improved rendering were not considered errors. It is not difficult to maintain close comparability of such scores for the two languages, provided the two sets of learning passages are of the *same content*, and provided the same experimenter works with both members of a pair of subjects on any given passage.

In summary, the effort was thus to control initial ability through selection of twins as the subjects; and to control the teaching by using the same experimenter, and learning materials of identical content, for each sitting with a pair of subjects. The variable tested was the "schematic" *vs.* the "naturalistic" emphasis in the language construction. (It is this variable or dimension which is causing controversy at present in the field of inter-linguistics; see Appendix I). The results are expressed in terms of time taken and errors made as the learners progressed, and also in terms of certain measures of net achievement at the end of the learning period.

III. SUBJECTS

The language background of the learners is clearly a factor of first importance in any work of this kind. We have taken only partial account of this factor in the present experiment, but it is our belief that it may be given fullest consideration through the use of the twin method represented here. That is, while the two pairs of identical twins utilized in this experiment were English-speaking subjects, one could, with proper inquiries in coastal cities of this country alone, find suitable twin pairs having almost any other language background which it might be important to consider. It is not commonly realized that there are about three identical twin pairs for every thousand persons of any given nationality, age, or status.

Given the language background with which it is desired to work, a consideration essential to the method is the *similarity* of that language background for the two members of each twin pair used.² The fact of the genetic or constitutional identity of identical twins is too well known to require discussion here. Frequently, and fortunately for our purposes, the members of such a pair are not only reared in a home background which is virtually the same for both individuals, but they go through the same schools, take the same courses, and typically show little more difference in their grades than could be expected considering the imperfections of grades and of teachers. Because there are marked exceptions to this picture, however, it is necessary to check the environmental backgrounds of the pair carefully, in addition to establishing the diagnosis of genetic identity. If there is material doubt on either count the pair should not be used.

In this experiment the subjects were a pair of dentists aged 29 who were without linguistic training, and another pair aged 24 who were medical students with a relatively extensive foreign language background. These pairs were chosen because of (a) certainty of the diagnoses of homozygosity, (b) the close intra-pair similarity of home and school background, and (c) the fact that these two pairs represented a considerable range of linguistic experience (see Table 1, Appendix I).

²It should be noted that this work is rather the converse of that in which the members of a pair of identical twins are approached with a view to measuring such possible differences as might have developed between them. Once their background similarity has been ascertained by consulting their school records and persons close to them, it should be made clear to the twins that they are asked to help because of the *fact of their similarity*, and *not* in order to test it; that the results can reflect only impersonal differences between the two languages, tasks, or methods tried, rather than differences between them as individuals.

IV. THE LEARNING PASSAGES

The essays of Thomas Henry Huxley were drawn upon for about one-third of the learning materials, both because his name holds prestige for persons having the scientific training of our subjects, and because of the vividness and diversity of style of his writing. Other passages consisted of humorous anecdotes and of selections from the writings of H. N. Shenton, H. G. Wells, Lancelot Hogben, and John Dewey. These 15 selections may be said to have been successful for the purpose, inasmuch as their content usually challenged and held the interest of the learners.

As well as the general orientation given on each language's basic structure, which was systematically covered in the first three sittings, one sitting was devoted to a presentation of the "correlative" words in each language. This sitting included oral drill with 24 very brief English sentences containing the common correlative forms.

TEST PASSAGE

After completion of the fifteenth learning passage, each subject was given the copies of all his translations and was asked to spend about an hour going over them and asking any further questions that occurred to him. He was reminded that the next sitting would be concerned with *translating 36 English sentences into his auxiliary language*; and that, although the content and the construction of these sentences would be taken largely from the passage materials, they would be used in somewhat changed form.

During this final sitting of unaided translation from English into their respective auxiliary languages, each subject was given a recess after his first 50 minutes of work. After returning to the work, he was encouraged and urged to keep trying just as long as he thought he might be able to improve anything by going back over his translation.

The four subjects' performances in translating these English sentences into *Sc* and *Na* languages provided the material for judging the *amounts* which the respective subjects had learned.

V. SUMMARY OF RESULTS

Considering first the results obtained on time and errors (see Table 2, Appendix I), and examining these data for *trend* from the beginning to the end of the learning period, there is found no tendency for the learning rate of the *Sc* language to approach that for the *Na* language. The results are best summarized by collecting the figures for the two *Sc* subjects and for the two *Na* subjects in the beginning stages of the learning, and comparing these with the same data for the later stages of the learning (Table A).

TABLE A

	Time (minutes)		Errors	
	<i>Sc</i> subjects	<i>Na</i> subjects	<i>Sc</i> subjects	<i>Na</i> subjects
Earlier passages	282 (100%)	272 (96%)	214 (100%)	151 (72%)
Later passages	356 (100%)	287 (81%)	158 (100%)	112 (71%)

The figures in parentheses are inserted to make possible comparisons on a percentage basis between *Sc* and *Na* performances. While the two *Sc* subjects, for example, took a total of 282 minutes on the beginning passages, the two *Na* subjects took a total of 272 minutes, or 96 per cent as much time on the same passages. The important result is not the fact that the figures are smaller at the beginning for the *Na* subjects than for the *Sc* subjects, but the fact that no tendency appears for the *Na* figures to approach the *Sc* figures during the later stages of the learning. This indicates that the initial advantage shown for the *Na* language was retained as far as we carried the learning process.

This result is not conclusive, however, because the figures cited above prove little so far as total amount learned is concerned. To estimate the amounts which the subjects had retained and could use actively, the performances of the subjects on the 36 English test sentences were carefully typed, and copies were distributed to Dr. E. C. Stillman of the International Auxiliary Language Association and to the three collaborators in this experiment. Each of these persons then scored the twins' work, independently and in whatever way each individual thought best. The results of these scorings are indicated in Table B.

Since such scorings are essentially *ratings* of performance according to the different criteria which the scorers believe are important, it is not surprising that the figures in this table vary a good deal from scorer to scorer. Stillman and Taylor took the sentence as a whole as their unit in giving credit; Stillman, however, did not look at the English sentence before deciding whether

TABLE B

Scorers	<i>Sc</i> subjects			<i>Na</i> subjects		
	Dentist	Medical student	Total points	Dentist	Medical student	Total points
Stillman	4	12	16	14	27	41
Taylor	7	18	25	14	33	47
Price	146	155	301	176	182	358
Kostin (<i>a</i>)	785	1,840	2,625	1,560	2,610	4,170
Kostir (<i>b</i>)	289	329	618	375	414	789

the subject's rendering was comprehensible as a meaningful sentence. Price gave a small proportion of his points for correctness of accidence, and the remainder for correctness of words. Kostir's (*a*) scoring took into consideration criteria of total comprehensibility, but was based largely on the percentage of total meaning actually conveyed, while his (*b*) scoring was more analogous to Price's.

No one of these scorings should be regarded as more valid than another, and the table should be read as a whole. With such material, it is important that various methods of scoring, based on different criteria, be tried. The significant point is that, for several independent scorings, the results appear to be in agreement as to trend.

These scorings should not be regarded as conclusive except in relation to the data on time and errors. Not only was amount of time taken to render the final English sentences less for the *Na* subjects than it was for the *Sc* subjects (167 minutes as compared with 210 minutes), but, as noted above, clear differences in time and errors favoring the *Na* language had held throughout the learning process.

VI. EVALUATION OF METHOD AND RESULTS

Depending on the type of language-learning problem studied in the future, it should be possible in one way or another to standardize better learning units than those used in this modest effort. The present study nevertheless shows, as was also indicated by the earlier work of Gesell and others, that problems of keeping extraneous factors under control in protracted learning tasks are readily reduced to manageable proportions through the use of identical twins as subjects.

As concerns practical findings of the present experiment, the results indicate that the autonomous word formations and other logical advantages enjoyed by the "schematic" type of emphasis *do not compensate for the advantages of the so-called "naturalistic"*³ *type of emphasis in an auxiliary language.* Not only was the factor of immediate recognizability or familiarity found to be very substantially in favor of the naturalistic (see Appendix II), but a highly sensitive technique has revealed a continuing lag in the learning of the schematic as compared with the naturalistic language. There appeared no reason to think that facility with the schematic language would approximate facility with the naturalistic if the learning had been carried twice as far up the learning curve.

It seems clear in conclusion that, for persons having language backgrounds like those of our subjects, an auxiliary medium does well to utilize to a considerable extent the established language forms which the naturalistic emphasis represents.

Although they are much more irregular, the language-habit-patterns of the naturalistic emphasis are not a great deal more complex than those involved in the schematic emphasis. It might therefore be doubted that Orientals, for example, would find the naturalistic patterns substantially harder

³The word "naturalistic" is, of course, rather a misnomer. However ingrained they may be, language forms are merely learned habits, so "naturalness" can hardly be assumed for any language whatsoever. The intended emphasis might better be termed "functionalistic," and defined as that which functions best for the users of the language, their ethnic language habits being what they are. Also, the expression "generalized language" or "standardized language" is much more suitable and correct than "constructed language" for an auxiliary language embodying such an emphasis.

It is important to note that the problem lies in finding an efficient auxiliary medium that can be *learned* easily, and not in finding something which could function easily *after* it has been learned to mastery. It is known, in fact, that Latino-sine-flexione and the original form of Esperanto—two languages which represent opposite extremes of the naturalistic-schematic variable—have both been used widely for years, and both have proved themselves equal to every demand made upon them so long as they are handled by individuals who have mastered them.

to learn than the schematic patterns. However, matters of this kind are much better judged when experimental results are available, and it is therefore to be hoped that procedures like those used in the present study will be tried also with several pairs of identical twins who know none of the European languages.

APPENDIX I: FURTHER DISCUSSION AND DATA CONCERN-
ING THE SUBJECTS, MATERIALS, PROCEDURES,
AND RESULTS

A. THE SUBJECTS' BACKGROUNDS

As noted above, the subjects of this experiment were a pair of twins aged 24 who were completing their first year of medical school, and another pair aged 29 who had completed their professional training and were practicing dentistry together. We are indebted to an authority on twins, Professor D. C. Rife of the Ohio State University Department of Zoölogy, for establishing the diagnoses of monozygosity of these pairs.

Table 1 summarizes the important features of the background environments

TABLE 1

	Medical students	Dentists
Home background	Father a professor. Twins separated occasionally on summer jobs. Have one younger brother.	Father owner of large local supplies business. Twins rarely separated. Have 4 younger and 5 older siblings.
Academic aptitude (Ohio College Assn. Test)	Both A rankings; scores differed by only 1 point, in favor of <i>Sc</i> twin.	Scores differed by half of one standard deviation, or about the difference between B and B+, in favor of <i>Na</i> twin.
Reading comprehension and speed (O. S. U. Test)	Tests not taken.	Scores differed by half of one standard deviation, in favor of <i>Sc</i> twin.
Language background (largely high school)	Each had 2 years of Latin and 2 years of French in high school. Each had 2 quarters of French and 2 quarters of German at Wooster College. No average difference in grades.	Each took 4 years of high school Spanish. No significant difference in averages of the grades received for the eight semesters.
Averages of grades ("point-hour-ratios") received at Ohio State University	In 2 years as graduate students taking Master's degrees in physiological chemistry, <i>Sc</i> averaged 3.54, <i>Na</i> averaged 3.50. In first year as medical students, <i>Sc</i> averaged 3.04, <i>Na</i> averaged 3.25.	In pre-dental school, <i>Sc</i> averaged 2.0, <i>Na</i> averaged 1.9. In School of Dentistry, <i>Sc</i> averaged 2.8, <i>Na</i> averaged 2.6.

of the subjects. Within each pair of twins, "*Sc*" refers to the subject who studied the language representing the schematic emphasis, and "*Na*" refers to the twin who undertook the language having the naturalistic emphasis. We judged these background data as indicating no consistent or substantial

intra-pair differences. The languages assigned to the *Sc* and *Na* subjects in each pair were determined by tossing a coin in the twins' presence.

Each of the four subjects was afforded \$20.00 as partial compensation for the time which he gave to the work of the experiment. It should be noted that, though more was not necessary, this amount was only in small part recompense for a subject's efforts. It simply permitted him to feel a little easier about the time actually lost to his studies or professional activities. For the rest, motivation depended on his interest in the work itself. Once the experiment was under way, that interest was genuine and continuing as far as we carried the work. For learning experimentation covering longer periods of time than we used, it would be only reasonable—and it would not be harmful—to pay full wages to the subjects for their efforts.

B. MATERIALS¹ AND METHOD

It should be understood that the schematic-naturalistic distinction is only a matter of degree. As will be seen from inspection of the samples of the learning materials in Appendix III, each language has both schematic and naturalistic features in considerable measure. The difference in emphasis between the two languages comprises, nevertheless, one of the most important variables running through those five or six auxiliary languages which are now candidates for general adoption. There are many further considerations which, taken together, are perhaps of equal importance to an international auxiliary language, and which account for the other differences among the candidate languages. But probably none of these considerations is causing as much controversy as the schematic versus the naturalistic emphasis. This happens, no doubt, because outside of experimentation no sound basis is available for deciding the issue which the schematic-naturalistic variable has raised.

Although Simplified Esperanto and Occidental were chosen for the work

¹The "naturalistic" language was Occidental, as presented in the symposium by Graber, Janotta and others: *Occidental, Die Weltsprache*, 1930, particularly the section *Repetitorie del grammatica*, pages 162-168.

The "schematic" language was Simplified Esperanto, as presented in our reprint (with additions) from the *Antiochian* for May, 1939; this is available from co-author Kostir upon request. The simplifications of Esperanto which we used were chiefly: (a) elimination of the special alphabetic characters and use of the internationally known digraphs *ch* and *sh*; (b) plurals in *-i* and infinitives in *-ar*; (c) non-obligatory agreement of adjectives; (d) greater use of international words; and (e) use of separate words for the common opposites. There can be little doubt that these changes operated to make the schematic language easier for our subjects than would have been the case had the original form of Esperanto been used.

only after consultation with competent interlinguists, we could not, in using these languages as they stood, control all language variables other than the schematic versus the naturalistic emphasis. Our data therefore concern two languages which differ markedly in one variable, and to some small extent in other variables. The results are adequate to judge the comparative learning rates of these languages, as *whole languages*. The criticism that this experiment has not completely explored the schematic-naturalistic variable would be proper, and the only answer is that a number of further tests using procedures similar to those of the present study ought to be undertaken as rapidly as developments in interlinguistic science permit.⁵

Except for the difference in the amount of drill requisite to the two languages (the *Sc* language necessarily requiring more drill), every effort was made to keep conditions even so far as matters relating to method were concerned. If a passage raised points of special interest to the first twin taking that passage, it was not difficult to see to it that more or less analogous points received stress also when his brother took the other rendering. When an extra point came up with the second twin to take the passage, it was easy to note and to mention it at the next sitting with his brother, and this was done as systematically as possible. We are convinced now, however, that there was small necessity for all of the pains taken, inasmuch as the virtually identical content of the two sets of learning passages took sufficient care of the problem of keeping things "balanced." The twins of course commented freely on the content of a passage after both had completed it, but were strictly observing of the rule against discussing it prior to completion. A fixed schedule alternating the first subject to start the passages was prepared but was not found necessary; without enforcing the schedule, things worked out easily so that each twin made half the starts.

C. FURTHER DETAILS ON THE SITTINGS

A long but relatively easy selection by Meillet was used for the first three

⁵With refinements of the techniques used herein, there is no reason why experimental work should not be carried out on a very considerable scale. The costs of such work are by no means great. In relation to the importance of the problems concerned, controlled tests yielding relatively certain knowledge would seem to be very well worth whatever purely technical trouble they might entail. Whether or not there is room for scientific method in the field of linguistics, there is obviously a place for it in interlinguistics. And nothing is more saving of prolonged and infertile controversy than to have checked the positions taken at every stage of development where it is possible to obtain experimental verification. With such checks open to inspection by any authority, one can much better expect that leaders in interlinguistic work will be persuaded to reconcile their various opinions.

sittings. It was treated as one passage at each of these sittings because the learner was thus afforded an excellent and non-discouraging introduction to his auxiliary language as a whole.

This was followed by a passage consisting of 21 commonly known proverbial statements, which were intentionally chosen to be familiar and recognizable at sight. Except for this set of proverbs, none of the passage materials selected had ever been seen by any of the four subjects. The remaining passages were arranged roughly in order of increasing difficulty and length, so that some of the later ones required more than one sitting for completion.

Including the final reviewing and the translating of the 36 English sentences, there were 18 sittings extending over a period of five weeks for the pair of medical students, and 26 sittings extending over a period of 14 weeks for the pair of dentists. We started with the latter before we started with the medical students. The dentists' sittings were spaced over the long period both because we were preparing the materials as we went along, and because their schedules of professional appointments made it more difficult for us to arrange mutually convenient times for sittings with them than was the case with the medical students, who were close at hand at the University. As we had anticipated, the more extensive language background of the medical students made it possible to carry out the program with them in substantially fewer sittings.

The medical students were on vacation during the work with the later passages, and so were able to complete the sittings a few days ahead of the dentists. It then became apparent that, although the subjects had known from the start about the English sentences to be tried at the end, we should have planned to give them additional practice at the task of rendering English into their auxiliary languages. For although they did as well as we expected, they thought this task very difficult, and felt they could have done better if we had given them more practice of this kind earlier.

With the pair of dentists, an extra sitting was therefore given prior to the reviewing and testing. During this sitting, each twin was assisted with the rendering into his auxiliary language of six English sentences different from any of those which comprised the final ones. This apparently succeeded in making the work of the final sitting seem much less of a sudden change of direction than had been the case with the medical students. While we would hold that this feeling of added difficulty due to the abrupt change was almost entirely "psychological," as the medical students themselves put it, and that it had little or no effect on the results, we would not recommend

in future work as sudden a change of direction as the medical students underwent for us in this experiment.

D. RESULTS IN DETAIL

As indicated above (Section II), effort was made to keep the subject occupied with the material at hand throughout each sitting. The time periods, in minutes, thus actually spent on the several passages, together with the errors made on them, are presented in Table 2. (The top part of

TABLE 2

	Time				Errors				
	Dentists <i>Sc Na</i>		Medical students <i>Sc Na</i>		Dentists <i>Sc Na</i>		Medical students <i>Sc Na</i>		
*1. Meillet without rules	35	35	35	35	—	—	—	—	
*2. Meillet with rules	41	41	41	41	—	—	—	—	
*3. <i>a.</i> Discussion of Meillet	31	31	—	—	—	—	—	—	
<i>b.</i> Completion of Meillet	30	30	30	30	—	—	—	—	
<i>c.</i> Lesson on Correlatives	20	20	30	30	—	—	—	—	
4. Common Proverbs	33	30	25	22	39	24	15	8	
5. Anecdote "Good Answer"	23	22	14	14	17	19	14	9	
6. Cephalic Index	14	13	9	8	10	7	4	6	
7. Anecdote "Diplodocus"	19	28	17	16	12	16	8	5	
8. Huxley on Aryans	36	34	21	27	30	21	14	7	
9. Hogben on Science	36	30	35	28	32	23	19	5	
10. <i>a.</i> Huxley on Language	30	26	—	—	22	13	—	—	
<i>b.</i> Repeated with additions	35	32	27	19	18	11	14	7	
11. Dewey on Evolution	22	28	23	21	11	6	3	2	
12. Shenton on Congresses	41	39	37	42	23	12	8	9	
13. Wells on PEN Club	70	51	47	39	34	24	13	14	
14. Huxley on Education	54	51	52	37	34	23	23	11	
15. Huxleyan Philosophy	67	60	66	49	34	27	20	13	
	480	444	373	322	(Totals)	316	226	155	96
Preliminary English sentences	45	45	—	—					
General review	62	66	54	51					
Time spent rendering the 36 English test sentences	100	84	110	83					

*During their first two sittings with the long Meillet passage, the twins worked without assistance and according to the same directions and time limits as were used in testing the initial success of groups of students (see Appendix II). Also, equal amounts of time were used *within each pair* for discussing and completing the Meillet passage, as well as for the lesson on correlatives. This procedure of controlling the time factor within each pair seemed to be a proper and effective way of getting the subjects started. At this stage the measurement of errors would hardly be in order and therefore no entries appear under "errors" for these sittings. However, the respective amounts of the Meillet passage grasped by the twins in their first two sittings are shown in Table 4 at the end of Appendix II.

this table will be clear in connection with the subsidiary experiment on recognition-testing explained in Appendix II.)

The fact that the record of time and errors showed no tendency for the learning of the *Sc* language to catch up with the learning of the *Na* language was contrary to what we had supposed would probably prove to be the case. Contrary also to what was actually happening toward the end of the sittings was the fact that one of the *Sc* twins *felt* sufficiently sure of his progress in grasping his language's word formations that he chided and slightly disturbed his brother with remarks that he was going to beat him on the final testing!

In summary, the *time* spent by the two *Sc* subjects on the 4th through 15th passages totaled 853 minutes ($480 + 373$), as compared with 766 minutes spent by the two *Na* subjects on passages of virtually the same content. The analogous totals with respect to *errors* made are 471 for the *Sc* subjects and 322 for the *Na* subjects.

The figures cited above (Table A) for "earlier" versus "later" passages in the learning process were obtained by totaling separately the figures for Passages 4 through 9, and for Passages 13 through 15.

APPENDIX II: INITIAL SUCCESS OF GROUPS OF STUDENTS
WITH THE SCHEMATIC AND NATURALISTIC LAN-
GUAGES AND AN EVALUATION OF THE
LANGUAGE BACKGROUND FACTOR

A. RECOGNITION TESTING

In a subsidiary project, opportunity was taken to secure measures of the degrees to which the *Sc* language and the *Na* language, as represented by the two renderings of the long Meillet passage, were understandable to groups of students lacking previous instruction.

The two renderings of the passage, *Sc* and *Na*, were mimeographed in closely similar formats, each having an introductory page explaining in English the purpose of the work. These blanks were given twice to sections of University students taking the general psychology course, at the beginning and at the end of the week during which they were studying language behavior.

At the beginning of the week, the students simply worked for 35 minutes in accordance with the following instructions on the blanks:

Measuring the Degree of Familiarity of an Auxiliary Language

An auxiliary language, carefully arranged from the words and forms already international in their use, is not an "artificial" language. Nearly everything in it is taken from the common stock of forms and words which have gradually developed in Europe. It is thus not surprising that the two or three auxiliary languages now being used are so much alike that a person who knows one can very easily learn to use another one of them.

Also, an auxiliary language is not, as some suppose, intended to displace any living or so-called "natural" language. It does provide simply a "second language for all." When such a language, for example, is used by international scientific abstracting services, a person will easily keep up with what is being done in his field in other countries,—without having to learn half a dozen difficult languages to do so. Thorndike has shown that fluency in an "A.L." can be acquired in less than 1/10 the time it takes to learn a "natural" language.

We are here studying the recognizability-at-sight of an interesting passage. It was written originally in French by a professor at the College of France, and has here been put into an auxiliary language.

DIRECTIONS: Please disregard what others may do with this. You will not be graded on it. Work quietly and rapidly on the passage, translating into English every word or expression for which the meaning looks fairly clear to you.

Avoid "wild" guessing, of course, but don't worry about getting something wrong. Use the thought of the passage or "context" as much in translating this as you would in translating anything else. Don't skip around but try the sentences *consecutively* as otherwise you may lose the sense of the passage. You may not complete it, but go

as far as you can in 35 minutes. The passage is spread out here for your convenience, but it is really only $1\frac{1}{2}$ pages long.

Write plainly, using a pen if possible. Don't take time to erase when you want to change something you have written. Simply draw a line through it, and write your change above what you wrote before. The passage is on "The many languages of Europe." So for example, you would indicate the translation of the title by writing *under* it, as:

La multa lingvi de Europa [on *Sc* blanks]

The many languages of Europe [mimeographed in handwriting on each blank]

Li mult lingues de Europa [on *Na* blanks]

The many languages of Europe [mimeographed in handwriting on each blank]

Now please read the 3 paragraphs of directions over again. Don't turn this page until your instructor tells you to start.

The *Sc* and *Na* renderings were alternated in passing out the blanks to the students. The blanks thus fell at random, and the two groups of students obtained in this way may be assumed to have been fairly comparable.

Lest motivation become unequal for these groups, no mention was made of the fact that the blanks contained two different renderings of the passage; even after the second administration of the blanks, very few students had observed two different renderings existed. Lest such an announcement affect absences, neither during the first administration of the blanks on Monday nor at any time during the week were the subjects informed that the Friday class period would be devoted to further work with the passage.

For the second administration on Friday, the names of the students who had taken the respective *Sc* and *Na* renderings on Monday had been written on the backs of further sets of the blanks, and they thus received face up the same renderings they had taken before. This time, however, the respective *Sc* and *Na* individuals were also given an extra mimeographed page headed "*Brief Rules.*" Each individual thus had before him a set of statements explaining the important features of the grammar of his language. Also, at the bottom of this page, 40 of the common short words occurring in the Meillet passage were listed alphabetically with their English equivalents. The two different sheets which the *Sc* and *Na* students received were not only similar in format, but were analogous in content throughout for the two languages.

These "Brief Rules" were first studied for six minutes by the students, who were then asked to proceed with translating the passage as before for 35 minutes, but this time keeping the sheet of rules and vocabulary alongside their blanks and referring to it whenever they thought it might be helpful.

The scoring of the translations was done by dividing the sentences of the passage into small phrases or groups of two to five words. There were 157 of these in all, and the divisions made for the *Sc* and *Na* renderings were very closely comparable. The ratings of correctness of the translations were then made on the following basis: 2 points were given for each of these phrases or groupings of words translated entirely or nearly correctly; 1 point was given if it was translated correctly in part; nothing was given where only a minor word was translated correctly.

The highest score obtained was one of 300 out of the 314 possible points, and the lowest score was 25 points. The difficulty of the material and the time limits set for the work thus proved to have been satisfactorily chosen.

B. RESULTS

Table 3 presents the results. It is considered that the raw data are best

TABLE 3

	Students taking the <i>Sc</i> rendering		Students taking the <i>Na</i> rendering	
	First admin. (Without rules)	Second admin. (With rules)	First admin. (Without rules)	Second admin. (With rules)
Numbers of students	51	45	51	46
Mean scores	91 (118)	144	136 (159)	182
SD's of scores	36 (42)	48	56 (60)	63

interpreted with statistics derived by averaging for each language the means and standard deviations of the "Without rules" and the "With rules" columns. These statistics are parenthesized in the table. One may thus speak of a difference of 41 points (159 — 118) in the averages of the *Sc* and *Na* performances. To be evaluated, this difference must be related to a standard deviation derived from the distributions of scores for both languages; this is found by averaging (root mean square) the two parenthesized standard deviations, or 51 points.

Using as one's yardstick this standard deviation of 51 points, and relating the 41-point difference between the *Sc* and *Na* performances to it, the *Na* translations are seen to average about 4/5 of a standard deviation better than the *Sc* translations. A difference of 4/5 of a standard deviation means that only about 22 per cent of the scores of the lower group exceed the median of the scores of the higher group. It follows that, among University fresh-

men, about the best 1 in 4 were able to get as much from the *Sc* rendering as the best 2 in every 4 did from the *Na* rendering.

If desired, the data for the "Without rules" administration alone may be analyzed separately. But short of a more extensive experiment in which two further groups could be given rules at their first administration, the "Without rules" and the "With rules" trials are best regarded as merely two stages of one task. The procedure was set up in these stages in order that the whole task might resemble the first approaches to an auxiliary language which a typical person is likely to experience. The results therefore indicate simply the comparative degrees of success in the two languages to be expected from such efforts.

It is true that, in terms of the units derived from this relatively easy passage, the *Sc* learners improved 53 points (91 to 144) while the *Na* learners improved only 46 points (136 to 182). Reflection will show that this may only mean that the *Sc* learners had much more progress to make, and that such figures depend in large degree on one's choice of material and units. Whereas materials of varying difficulty can change the relationships derived from such "raw" units to a marked extent, this is much less true for the analysis given above in terms of standard deviations.

C. LANGUAGE BACKGROUND AS A FACTOR

Another of the purposes of testing these groups of students with the Meillet blanks was that of studying the degree to which language background affects one's initial performance with an auxiliary language. Accordingly, the number of terms or quarters of course work completed in Latin, French, Spanish, Italian, and German was obtained from each of the 102 students, together with a brief description of further background from those individuals who had a speaking or reading knowledge of one or more foreign languages outside of course work.

A measure of language background was then derived for each student by counting as 1 point each term or quarter of course work taken in a foreign language, and adding 2 to 6 points to the measure in the cases of those individuals who had further knowledge of languages in connection with their home backgrounds. (As it happened, the students taking the *Sc* rendering were found to average 8.9 of these points; those taking the *Na* rendering averaged 8.6.)

These estimates of language background were correlated with the scores made on the Meillet passage. The correlation coefficients were found to be

TABLE C

	Students taking <i>Sc</i> language	Students taking <i>Na</i> language
Without Rules (1st Administration)	.41	.51
With Rules (2nd Administration)	.47	.68

as given in Table C. These figures merely indicate how closely scores on the passage *correspond* to amounts of language background, and are not to be confused with average performances, of which such correlations are altogether independent.

The *differences* among these correlations are perhaps in expected directions, but are not large enough to allow of safe generalization. The results do show, however, that language background correlates around .50 with scores, for such material and for such a group. If general intelligence and language background are considered the two important variables contributing to one's score, then, in the light of the fact that the above correlations are by no means high, it is possible to surmise that general intelligence probably affects one's first success with an auxiliary language quite as much as does his language background.

D. THE TWINS' RECOGNITION SCORES

With reference to Table 2, it will be recalled that the introductory sittings with the four twin subjects consisted of work with the Meillet passage also. The twins did not translate the blanks in a "classroom" situation, and they knew, of course, both that the blanks contained different renderings and that the learning work was to continue. Otherwise the same procedure and the same blanks were used with each pair as were used in the recognition-testing just described. The eight scores made by the twins in their first two sittings with the Meillet passage are presented in Table 4. Remembering that the standard errors of any such individual measures are considerable, these scores may be said to parallel the group data of Table 3 about as closely as could be expected.

TABLE 4

	Scores of the <i>Sc</i> twin subjects on the <i>Sc</i> rendering of Meillet		Scores of the <i>Na</i> twin subjects on the <i>Na</i> rendering of Meillet	
	Without rules	With rules	Without rules	With rules
Dentists	63	123	89	178
Medical students	143	229	201	282

APPENDIX III: SAMPLES OF THE LEARNING MATERIALS
AND TEST PASSAGE

Below are the last paragraphs of the 15 learning passages, as rendered in the "schematic" language for use by the two "Sc" subjects. The total length of the learning passages was approximately four times the amount of material reproduced here.

1, 2, and 3. *Meillet on the Many Languages of Europe.* "Un moderna erudito estas, chu li volas o ne, la kunlaboranto de omniuj, kiuj en la tuta mondo kultivas la sama scienco. La scienco, kiu estas unuo, dominas un tekniko, kiu anke estas unuo. Omniu sciencia eltrovaĵo ĉanĝas la procedi de fabrikado et la cirkonstanci de produktado. Et omniu nova procedi de fabrikado estas rapide konata en la tuta mondo.

"La komerca aferi estas internacia. La industrio de unu speco establas karteli trans la borderi. La banki de la tuta mondo estas interligata per komuna operaci. La fer-voyi, la shipi, kiuj posibligas la relati inter homi, devas ijar simila, per neceseco. La posta servado estas devigita unuĵar por konformar sin lau la principi de la universala posta unio.

"En la sama grado kiel la civilizacio ijar pli unuforma, la lingvi devas esprimi la sama aferi per materiale diversa sed paralela procedi. La ideci ne varias kun la vorti, kiuj esprimas ilin. La lingvi de Europo, per tio kion ili esprimas, tendencas ijar la fidele analogi unu de la alia."

4. *Proverbs.* Un bona komedio estas pli daŭra ol un sistemo de filosofio.

La sapo estas la mezuro de bonstato et kulturo de un popolo.

Genio estas unu procento inspirado et naudek-naŭ procento svitado.

5. *Anecdote "Good Answer."* "Vi povus posible esti la posedanto de tiu bela mikra domo, kiun vi vidas tie-ĉi dextre."

"Ĉu vi scias, kies ĵi estas?" "Ne." "Ĵi apartenas al mi!"

6. *T. H. Huxley on Cephalic Index.* "Mi povas citi la precedento de la bona Angla vortoj 'thick-head' et 'block-head,' por *larja-kaĉo* et *longa-kaĉo*. Estas posibla uzi la teknika terminoj 'brakicefala' et 'dolicocefala.' Sed on ne povas diri ke ili estas multe pli eleganta."

7. *Anecdote "Diplodocus."* Kiam mi estis tie, un olda sinjorino, kiu rigardis la giganta dinosaŭro, diris: "Estas neposibla! Eĉ se un tia besto vere vivis, kiel on povis eltrovi ĵi nomo?"

The paragraphs below correspond to those on the left-hand page, except that they are here rendered in the "naturalistic" language for use by the "Na" subjects.

1, 2, and 3. *Meillet on the Many Languages of Europe.* "Un modern erudito es, si il vole o ne, li collaborator de omnes, qui in li tot monde cultiva li sam scientie. Li scientie, quel es un, dómina un technica, quel anc es un. Chascun scientific decovriton changea li procedes de fabrication e li conditiones de production. E omni nov procedes de fabrication es rapidmen conosset in li tot monde.

"Li commercial afferes es international. Li industries de un branche concluda cartelles trans li frontieras. Li bancs del tot monde es alliat per comun operationes. Li rel-vias, li naves, queles fa possibil li relationes inter homes, deve devenir simil, caus necessitá. Li postal servicie ha esset fortint unificar se por conformar se secun li principies del universal postal union.

"In li sam gradu quam li civilisation deveni plu uniform, li lingues have a expresser li sam coses per materialmen different ma parallel procedes. Li notiones ne varia con li paroles, queles expresse les. Li lingues de Europa, per to quo ill expresse, tende a devenir li fidel analogies de unaltru."

4. *Proverbs.* Un bon comedie es plu durabil quam un systema de filosofie.
Li sapon es li mesura de bon-esser e cultura de un popul.
Genie es un percent inspiration e ninant nin percent transpiration.

5. *Anecdote "Good Answer."* "Vu vell posser forsan esser li possessor de ti bell micri dom, quel vu vide ci a dextri."

"Esque vu save, de qui it es?" "No." "It apartene a me!"

6. *T. H. Huxley on Cephalic Index.* "Yo posse citar li precedent del bon Anglesi paroles 'thick-head' e 'block-head,' por *larg-cap* e *long-cap*. Es possibil usar li technic terminos 'brachycefalie' e 'dolichocefalie.' Ma on ne posse dir que ili es mult plu elegant."

7. *Anecdote "Diplodocus."* Quande yo esset ta, un old seniora, qui regardat li gigant dinosaur, dit: "It es impossibil! Etsi un tal animal vremen ha vivet, qualmen on posset descovrir su nómine?"

The last paragraphs of the learning passages as rendered in the "schematic" language are continued below.

8. *Huxley on Aryans.* "Kiel la aplikado de la ekspresajo 'Latina raso' al la diversa popoloj kiuj hodie parolas la Romana lingvo ne estas men absurda ĉar ĝi estas ofta, tiel estas egale nekorekta nomi la popoloj kiuj parolis la primitiva Aryana dialekto la 'Aryana raso.'"

9. *Hagben on Science.* "Ni reestablos la supremeco de la racio nur kiam ni povos edukar politikistoj kiuj havas unu vizio de tio, kio la homa vivo povus esti, se la vasta trezoro de la scienco scio estus dediĉita al la komuna bezono de la homaro."

10. *Huxley on Language.* "Et un raso de muta homoj, senigita je omnia komunikado kun tiuj kiuj povas paroli, estus miksa diferenco de la bestoj. La morala et intelekta diferenco inter ili et ni mem estus praktike senlima, kvankam la naturisto ne povus trovi unu ombro de struktura diferenco inter ili et ni mem."

11. *Dewey on Evolution.* "Per meti la manoj sur la sankta arĥeo de la absoluta konstanteco, per trakti la formoj kiuj estis rigarditaj kiel tipoj de la fikcio et perfekteco kiel originantaj et departantaj, *La Origino de la Specioj* iniciatis unu modon de la pensado kiu finale devis transformi la logikon de la mondo."

12. *Shenton on Congresses.* "Dum la unua jardeko de internacia konferencoj (1840-1849), okazis mez-nombro nur unu de tiaj konferencoj jare. Nun okazas pli ol tri cent konferencoj jare. Kelkfoje unu konferenca sesiono altiris milojn de delegitoj el dozoj de nacioj, et reprezentas unu astonantaĵon de mono, tempo, et peno."

13. *Wells on PEN Club.* "Mi esperas et kredas ke s-ro. Jules Romains kontinuos subteni la esencajn principojn kiujn la PEN Klubo reprezentas en la tuta mondo, nome:

"La libereco de ekspresado et kritikado, et sincera et amika frateco et reciproka toleremo inter omnia honestaj skribistoj, pensuloj, et kreantoj, kiel forte ajn la materialo et formo de ilia ekspresado diferencas."

14. *Huxley on Education.* "Vice de devigari artefaritajn limojn sur la akirado de sciado per la virinoj, ĵetu omniaj facilcoj al en ilia vojo. Se oni povas venkar mem-evidentajn praktikajn defacilecojn, lasu ke tiuj virinoj kiuj sentas la inklinaĵon tiel fari, iĝas komercistoj, juristoj, et politikistoj. Lasu ke ili havas unu ĵustan oportunon."

15. *Huxleyan Philosophy.* "Kompreneble ni, unufoje por omniaj, ke la etiko progresas de la socio dependas, ne de imiti la kosman procedon, et eĉ men de forkuri de ĝi, sed de batali ĝin. La historio de la civilizado detalas la paŝojn per kiuj la homoj konstruis unu artefaritan mondon interne de la kosmo."

The last paragraphs of the learning passages as rendered in the "naturalistic" language are continued below.

8. *Huxley on Aryans.* "Qualmen li application del expression 'Latin rasse' al divers popules queles hodie parla li Romanic lingues ne es minu absurd pro que it es frequent, talmen it es egalmen incorrect nominar li popules queles parlat li primitiv Aryan dialectes li 'Aryan rasse.'"

9. *Hogben on Science.* "Noi va reestablisser li suprematie del rason solmen quando noi posse educar statmannes qui va haver un vision de to, quo li homan vive vell esser, si li vast tresores de scientie conoscentie vell esser dedicat al commun besones del homanité."

10. *Huxley on Language.* "E un rasse de mut homes, privat de omni communication con tis queles posse parlar, vell esser poc different del besties. Li moral e intellectual differenties inter les e nos self vell esser practicalmen infinit, quancam li naturalist ne vell posser trovar un ombre de structural differentie inter les e nos self."

11. *Dewey on Evolution.* "Per metter li manus sur li sacri arca del absolut permanentie, per tractar li formes quel hat esset regardet quam types del fixité e perfection quam originante e departiente, *Li Origine del Species* iniciat un mode del pensade quel finalmen devet transformar li logica del conoscentie."

12. *Shenton on Congresses.* "Durant li unesim decennie de international conferenties (1840-1849), evenit medialmen solmen un de tal conferenties annualmen. Nu eveni plu quam tri cent conferenties annualmen. Quelevez un sol conferential session attraet milles de delegates ex dozones de naciones, e representa un astonant expense de moné, tēmpore, e exfortie."

13. *Wells on PEN Club.* "Yo espera e crede que sr. Jules Romain va continuar mantener li essential principies queles li PEN Club representa in li tot munde, ad saver:

"Li libertá de expression e criticism, e franc e amical fraternité e reciproc tolerantie inter omni honest scrittores, pensatores, e creatores, quamecun fortmen li substantie e form de lor expression mey differer."

14. *Huxley on Education.* "In vice de imposar artificial restriccionas sur li atinyament de saventie per li feminas, ples jeter omni facilitás in su via. Si on posse victor self-evident practical desfacilitás, lass que ti feminas qui senti li inclinacion tal far, deveni mercantes, avocates, e politicos. Lass les haver un just chance."

15. *Huxleyan Philosophy.* "Lass nos comprender, unvez por sempre, que li etical progress del societá depende, ne de imitar li cosmic process, e mem minu de forcurrer de it, ma de combatter it. Li historie del civilisation detala li passus per queles li homes ha constructet un artificial munde intra li cosmos."

TABLES USED IN THE LESSON ON "CORRELATIVES"

<i>"Schematic" Language. (Simplified Esperanto)</i>			
what kio	that tio	everything omnio	nothing nenio
who kiu	that (one) tiu	everyone omniu	no one neniu
where kie	there tie	everywhere omnie	nowhere nenie
when kiam	then tiam	always omniam	never neniam
<i>"Naturalistic" Language. (Occidental)</i>			
what quo	that to	everything omnicos	nothing necos
who qui (quel)	that (one) ti	everyone omni	no one nequi
where ú	there ta	everywhere partú	nowhere necú
when quande	then tande	always sempre	never nequande

Test Passage of English Sentences Used for Estimating Amount Learned

1. To say is easier than to do.
2. One cannot argue about tastes.
3. He laughs best who laughs last.
4. Two half truths do not make one truth.
5. How many cigars did you smoke today, four or five?
6. The physiological value of a cephalic index over eighty is unknown.
7. Looking at the immense skeleton, the lady said, "It is impossible."
8. Even if such an animal truly lived, how were they able to discover its name?
9. Do you know who once owned that beautiful small house?
10. He knows the names of almost all the persons whom Mr. Blank brought here.
11. After I see him there, the first thing which I must do is to find your room.
12. What is it that makes man what he is—what other than his power of language?
13. This functional difference might depend on structural differences which are wholly insensible to us, with our present means of research.
14. The moral and intellectual differences between a race of dumb men and ourselves would be practically infinite.
15. The world will certainly seem to become smaller during the twentieth century.
16. All new processes of manufacture and production are rapidly known in the whole world.
17. It is necessary to have a common language in order to have true discussion.
18. During the last decade, more than three hundred international conferences occurred annually.
19. Sometimes the largest part of the time money, and effort was spent for translations, and the loss of common understanding was incalculable.
20. For those who must follow the work done in the world, the diversity of languages complicates matters in an intolerable manner.
21. If we had better communication, we could profit more from our contacts with each other.

22. We know no facts which show that one race cannot use the language of another race.
23. Community of language does not prove unity of race; it is not even probable evidence of racial identity.
24. The social sciences have nothing to lose by closer attention to advancing knowledge of human nature.
25. The feminine type of character is neither better nor worse than the masculine type.
26. Those who were responsible for the education of women did not suppose that motherhood would require less time in the future than it did before.
27. Recognize that whatever justifies a kind of education for boys, will justify its application to girls also.
28. Let those women who feel inclined to do so have the same education, and work in the same occupations, as the men.
29. He hopes to continue to work during several years yet with our club—although not as its president.
30. These famous writers wish to maintain liberty of expression and criticism, however strongly their opinions differ.
31. John Dewey believes that the concept of evolution must change the logic of thought and knowledge.
32. When scientists think too narrowly, they fix the limits of their progress.
33. Then, as now, certain thinkers hoped that society would grow better if no one tried to change it.
34. Such illusions are very human, but they are errors nevertheless.
35. Let us understand that civilization depends on creating an artificial world within the natural world.
36. We must educate statesmen who will have a vision of what human life could be, if the vast treasures of science were dedicated to common needs of mankind.

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